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Analysis of the Comparative Economic Advantage of Alternative Agricultural Production Options in Tanzania

Final Report

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Foreword

Southern Africa was characterized by a heavily regulated agricultural market before the late 1980s but, since then, countries in the region have followed a strategy to remove restrictive measures from the agriculture sector. The deregulation process has taken place within the context of worldwide liberalization of agriculture. These changes have meant that Tanzania, and the entire southern African region, has to compete internationally in a more open agricultural market. In order to be competitive, southern African countries have to use resources more efficiently by exploiting their comparative advantages. Policy and decision-makers should be guided so as to implement policies and strategies that will enhance the competitiveness of agricultural producers.

Various studies have shown that countries can improve their welfare by opening up their borders to freer trade. Furthermore, there is a worldwide move toward economic integration; the European Union probably being the most prominent example. Southern Africa is no exception with the region's move toward a Free Trade Area under the auspices of the Southern African Development Community (SADC). Not only is it foreseen that this movement will improve welfare in the whole region, but the region's competitiveness could also improve. Within the framework of economic integration in southern Africa, countries will only reap benefits by exploiting comparative advantages that may exist within the region.

Tanzania is one of seven countries in SADC participating in the Research Program on Regional Agricultural Trade and Changing Comparative Advantage in Southern Africa. The comparative economic analysis (CEA) study in Tanzania, therefore, forms part of a larger activity to determine comparative advantages in the region. These studies not only examine the existing comparative advantages, but also provide a means to evaluate the impact of different agricultural policies on comparative advantage. This proves to be an especially valuable tool to guide policymakers in the region.

The Tanzania study makes a significant contribution toward establishing the country's comparative economic advantage in producing cotton in the Western Cotton Growing Area (WCGA), coffee in the southern zone, and rice in Morogoro. The findings of the comparative economic analysis also reveal the need for revised policies relating to the agriculture sector. These include the need for measures to reduce production constraints and improve farm gross margins so that resource allocations to competitive crops can take place. In addition, measures need to be taken to improve product quality given the potential for high quality output and the world market's high demand. Further policy measures are needed to improve Tanzania's processing capacity and to facilitate additional research on the role of competing products, especially those that compete with cotton and their effect on the domestic textile milling industry.

This study is one in a series of studies on Africa's regional trade and comparative advantage, a joint activity of USAID Africa Bureau's Office of Sustainable Development, Agriculture, Natural Resources and Rural Enterprise (ANRE) Division and the Regional Economic Development Services Office for Eastern and Southern Africa (REDSO/ESA).

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Dedication

Dedicated to the memory of the late Professor Glenn Themba Magagula, formerly Deputy Vice Chancellor of the University of Swaziland, whose vision, foresight and leadership led to the development and implementation of the “Regional Trade and Comparative Economic Advantage in Southern Africa” activity.

Executive Summary

A new economic and political order in southern Africa is unfolding with the admission of the Republic of South Africa into regional groupings. Bilateral and regional efforts are taking place to promote economic integration. It is anticipated that these developments will lead to various changes in economic policies, trade regimes, and protectionism. Such changes are expected to have significant implications for the Tanzania economy, especially in the production and trade of agricultural commodities and in the nation's drive for food security. Through a Co-operative Agreement between the University of Swaziland and USAID/ REDSO/ESA, a regional research activity on Regional Agricultural Trade and Changing Comparative Advantage in Southern Africa has been undertaken.

In order to take full advantage of the reform policies in stimulating growth and development, strategies that take into account the differences in comparative economic advantage within the country and between countries in the region are important. This is of particular significance with the growing emphasis on economic integration among SADC countries.

This study is guided by the comparative advantage analytical concept. Comparative advantage is best assessed by comparing current levels of domestic opportunity costs relative to market prices in trade. Empirically comparative economic advantage analysis can have two meanings. The first is the comparison of efficiency of production among two or more trading nations. Theoretically, nations with the lowest opportunity costs are relatively more efficient and therefore have a comparative advantage (Tsakok, 1990; Masters, 1995; Masters and Winter-Nelson, 1995). The second meaning of comparative advantage is to compare the efficiency of different kinds of production within the domestic economy. These are compared in terms of earning or saving foreign exchange. The two meanings nevertheless imply each other. If domestic production costs are less than in other countries, then the economy gains in efficiency terms in producing the tradeable good. The principle of comparative advantage is therefore anchored on the assertion that countries will respond to increased opportunity to trade by exporting more of those commodities which they are able to produce relatively cheaply and import more of those commodities which are expensive to produce at home. (Evans, 1997). For example, a country with a higher ratio of labor to land than its trading partners is expected to specialize in the production of labor intensive commodities and import most of its land intensive commodities from those countries which have higher land-labor ratio (Deordorff).

This study is very important to countries in the region to indicate policy measures that are required to increase inter-regional trade due to bilateral as well as regional efforts and the new economic and political order in South Africa.

OBJECTIVES

The overall objective of the regional project is to analyze the comparative economic advantage (CEA) of alternative agricultural production options. Under the overall objective of the regional project, the study in Tanzania attempts to achieve the following specific aims:

1. Evaluating the comparative economic advantage of alternative agricultural production activities in various ecological zones, under different levels of technology and land tenure systems;
2. Analyzing the potential impacts of removing existing price and policy distortions on the economic efficiency of alternative productive uses of country's resources;
3. Identifying points of policy, technology, and institutional intervention to enhance economic efficiency and direct agricultural resources to their

most productive uses; and

4. Building the Tanzania data component needed for conducting regional analyses of comparative economic advantage in agricultural commodities for Southern Africa.

BACKGROUND

Tanzania is located 12° South of the Equator, bordered by Kenya and Uganda in the North, Democratic Republic of Congo (Congo), Rwanda, Burundi in the west; Zambia and Malawi in the southwest; while Mozambique is found in the south. On the eastern side, the country is bordered by the Indian ocean. Mainland Tanzania covers 942,800 km^2 of land area and 61,500 km^2 of inland water bodies. The climate is largely tropical although regional variations are wide, which also dictate the agricultural potential of the different zones, which is principally determined by moisture availability. Irrigation is minimal, and thus agriculture is basically rain-fed.

Agriculture is the foundation of the Tanzania economy, as it supports employment for a very large percentage of the population and provides food and exports. About 84% of the employed population work in agricultural related activities, producing 61% of both gross domestic product (GDP) and merchandise exports by 1992. On average, agriculture accounts for no less than 50% of the total GDP. Within agriculture, the crop sub-sector (made up of exports and domestic crops) accounted for 63% of agricultural production between 1976-1991 (URT, 1995). Of the domestic crops, cereals are dominant, whereas the major export crops are cotton, coffee, tea, tobacco, and pyrethrum.

AGRICULTURAL TRADE BETWEEN TANZANIA AND OTHER COUNTRIES

According to 1995/96 survey data, it is indicative that Tanzania has a net benefit in the agricultural commodity trade with its neighbours. Both a combination of volume traded and relative prices contribute to the positive net effect of cross-border trade to Tanzania.

Prices of the traded commodities vary and fluctuate throughout the year as do import and export prices. This variation emanates mainly from seasonality of production. It is notable that the mean annual export prices for most of the selected crops, i.e. maize, beans and wheat are higher than import prices for the same. This further explains the edge Tanzania has against its neighbouring countries. Even crops that move in both directions (to and out of Tanzania) acquire higher prices in seasons that Tanzania is exporting.

APPROACH AND METHODS

In the 1980's Pearson devised the Policy Analysis Matrix (PAM) as a formal way to derive determinants of comparative economic advantage. Several measures of economic efficiency can be explicitly traced to specific elements of the PAM. For this reason the PAM became a popular way of presenting policy-analysis and project-appraisal data.

For the purpose of this study, domestic resource cost (DRC) has been adopted to measure the comparative economic advantage. DRC is an analytical tool for empirical evaluation of economic efficiency among alternative enterprises and is a commonly used criterion for measuring CEA. For any production option to be the most efficient user of the country's resources, two conditions need to be met: First, the foreign exchange cost of the domestically produced product must be less than its import price at the same foreign exchange value, i.e., the cost of producing the product domestically must be less than the cost of importing the same product. Secondly, the net foreign exchange gain from producing that product must exceed the net economic gain foregone from using the same amount of domestic resources to produce alternative products, i.e., the gains from using resources such as land, labor, capital, and water must be greater that the opportunity cost of using these resources in other production activities.

Several factors are likely to influence the measurement of the comparative advantage and must be taken into account. The following convention was adopted to group commodities according to these factors:

1. As recommended by the joint study by the Project's Steering Committee in its meeting of June 1995 in Pretoria, the agro-ecological zonation approach has been used as the framework for classifying production environments according to biophysical conditions.
2. Differences within agro-ecological zones (AEZ) due to variations in technology, tenure, etc., have been captured by coding every production system as a distinct activity.
3. Variations in market and infrastructure factors are reflected in prices and transportation costs. These variations have been captured by defining a central market node for every commodity at which all trade will be assumed to take place. Consequently, prices and transport costs between these market centers (nodes) reflect the opportunity cost of producing a commodity locally versus importing it from another region/zone or from another country.
4. Variations in resource endowments are reflected in the relative rental values of those resources in the different market centers.
5. Policy distortions are captured by measuring the divergence between market and social prices of goods and services on the input and product sides.

It is worthy to note the vastness and complexity of Tanzania in terms of climate, soils, and topography. A number of studies have attempted to classify the country into agro-economic zones. According to the LRDC classification, there are seven major agro-ecological zones: Coast, Arid lands, Semi-arid lands, Plateaux, Alluvial Plains, Southern and Western Highlands, Northern Highlands and isolated granitic mountains. In terms of agricultural potential, the regions of Tanzania are divided into three broad categories: (1) high potential areas¾ the highlands, alluvial plains and plateau; (2) intermediate potential areas¾ coastal and semi-arid lands and (3) low potential areas¾ arid lands.

The data for the empirical case studies of the selected products were obtained from commodity chain studies and government official publications. The commodity chain studies involved the tracing of the commodity from production to the final consumption point. In doing so all costs involved from production, marketing, processing to consumption are taken into account. The secondary data collected include standard coefficients, prices and tax rates.

Ideally each major zone and farming system could be represented by the important enterprises produced there. Furthermore it is necessary to include under each enterprise any other variations based on location, enterprise size and any other important variations. The task of assembling such an amount of data so as to take into consideration all of the above variations would have been very costly indeed. Therefore the crops studied were selected according to data availability within the time and cost dimension.

THE PAM RESULTS

Morogoro rice, Morogoro maize, and Northern arabica coffee had Nominal Protection Coefficients (NPCs) of greater than one while southern arabica coffee and cotton from the western growing area had NPCs less than one. It means that those enterprises with NPCs greater than one were protected by the prevailing government price policy while the other enterprises were taxed. Corresponding results are obtained by the inspection of Effective Protection Coefficient (EPC) results for the enterprises under consideration.

The study also discovered that the country possessed comparative economic advantage in all the enterprises except Morogoro maize and Northern highlands coffee.

Glossary of Acronyms and Abbreviations

ADIS	Agricultural Diversification and Intensification Study
AEZ	agro-ecological zone
CEA	comparative economic advantage
CIF	cost insurance and freight
Congo	Democratic Republic of Congo
DRC	domestic resource cost
DSM	Dar-es-Salaam
ECGA	Eastern Cotton Growing Area
EPC	effective protection coefficient
ESA	Eastern and Southern Africa
FOB	free on board
GDP	gross domestic product
ha	hectare
hr	hour
kg	kilogram
km	kilometer
KNCU	Kilimanjaro Native Co-operative Union
LRDC	Land Resources Development Center
m.a.s.l.	meters above sea level
MDB	Marketing Development Bureau
mm	millimeters
MT or T	metric ton
n.a.	not available
NAFCO	National Food Company
NPC	nominal protection coefficient
NSP	net social profit
PAM	Policy Analysis Matrix
PCR	private cost ratio
REDSO	Regional Economic Development Services Office

SADC	Southern African Development Community
SHIFA	Southern Highlands Farmers Association
Shs	Tanzania shillings
TCB	Tanzania Coffee Board
TFA	Tanzania Farmers Association
TFC	Tanzania Fertilizer Company
URT	United Republic of Tanzania
US$	United States dollar
USAID	United States Agency for International Development
WCGA	Western Cotton Growing Area

1. Background

Tanzania is located 12° South of the Equator, bordered by Kenya and Uganda in the North, Democratic Republic of Congo (Congo), Rwanda, Burundi in the west; Zambia and Malawi in the southwest; while Mozambique is found in the south. On the eastern side, the country is bordered by the Indian ocean. Mainland Tanzania covers 942,800 km^2 of land area and 61,500 km^2 of inland water bodies. The climate is largely tropical although regional variations are wide, which also dictate the agricultural potential of the different zones, which is principally determined by moisture availability. Irrigation is minimal, and thus agriculture is basically rainfed.

Agriculture is the foundation of the Tanzania economy, as it supports employment for a very large percentage of the population and provides food and exports. About 84% of the employed population work in agricultural related activities, producing 61% of both gross domestic product (GDP) and merchandise exports by 1992. On average, agriculture accounts for no less than 50% of the total GDP. Within agriculture, the crop sub-sector (made up of exports and domestic crops) accounted for 63% of agricultural production between 1976-1991 (URT, 1995). Of the domestic crops, cereals are dominant, whereas the major export crops are cotton, coffee, tea, tobacco, and pyrethrum.

1.1 AGRICULTURAL TRADE BETWEEN TANZANIA AND OTHER COUNTRIES

Export crop production declined between the mid-1970s and the mid-1980s. It is hypothesized that this decline was mainly caused by disincentives of the domestic policies. The decline was further exacerbated by the fall in international prices for the traditional agricultural exports. As the country implemented the Economic Reform Program and therefore the institutionalization of incentives towards agriculture, the export sectoral decline was arrested. Traditionally agricultural export products from Tanzania have been exported to Europe, Asia, and North America. In recent years, trade with Tanzania's neighbors has been growing rapidly. Food is the main export to regional markets but there is a possibility to increase the export of non-food agricultural products. In addition, Tanzania is in an advantageous position due to its access to the sea and the potential for agricultural land expansion by the utilization of the idle land.

Tanzania relies heavily on traditional export crops for 40 to 50 percent of export revenue. Crops which contribute significantly are coffee, cotton, tea, cashew nuts and to a lesser extent tobacco, sisal, and pyrethrum. The value of coffee and cotton exports has been increasing from 1992 to 1995 (Table 1.1).

Tanzania has similar problems faced by other sub-Saharan Africa countries in the international markets. Income terms of trade for its nine major traditional exports declined at a rate of 4.2 percent per annum between 1975 and 1990 (World Bank, 1994).

With regard to official international markets, a vexing question continues to be: How much importance should Tanzania give to increasing production for commodities facing inelastic world demand and a secular deterioration in world prices? It is important to note that coffee and cotton prices in 1995 were 50 percent lower than what they were in 1980 in real terms. The decline in prices is explained as a function of growth in production at a rate that exceeds that of world demand.

1.2 REGIONAL TRADE IN AGRICULTURAL PRODUCE

Within the region, a slightly different story can be explained regarding Tanzania's trade. For many of the countries in central Africa, access to the sea is via Tanzania. Some of these countries on occasions suffer from short-

Table 1.1. Tanzania's Coffee and Cotton Export Trends

Crop		Units	1993	1994	1995
Coffee	000 Tons	52.7	58.5	37	47.9
	Value: Mill Shs	31,123	31,761	53,816	69,563
Cotton	000 Tons	71.7	61.2	60	70.8
	Value: Mill Shs	31,123	31,761	53,816	69,563

Source: URT, 1994

ages of food. Malawi, Rwanda, and Burundi, for example, seem to have almost exhausted their high-potential land. Tanzania, due to the wide geographical spread of her productive areas and a variety of her agro-ecological climates, rarely suffers from drought across the whole country. According to the World Bank (1994), Tanzania's trade with her neighbors has been growing rapidly. Food is an obvious candidate for trade.

Tanzania maintains a net trade surplus with all her neighboring countries except Kenya, a favored trading partner. Exports to Kenya made up about 50 percent of Tanzania's imports. It is imperative to mention at this juncture that official statistics pose serious limitations in such a study intending to reflect on comparative economic advantage within the region. A better reflection of market forces determining flow of goods from one country to another can be made using unofficial trade. The following section presents insights to this part of trade between Tanzania and her neighbors.

1.3 UNOFFICIAL CROSS-BORDER EXPORTS

Cross-border trade can be a good indicator of comparative advantages existing in neighboring countries. The nature and trend of cross-border trade in Tanzania, however, has been influenced by the effects of pre- and post-liberalization policies. In the mid 1980s, following the centralized economic policies, declining output across all sectors; controlled exchange rates; falling exports; poor import capacity; widespread quantitative restrictions of imports and severe scarcity of consumer commodities characterized Tanzania's economy. This led to a growing parallel market internally and for both imports and exports with neighboring countries. Maliyamkono and Bagachwa (1990) is the most illustrative document regarding the shadow economy in Tanzania while Ackello-Ogutu and Echessah (1997) document the magnitude of cross-border trade between Tanzania and her neighbors.

Unofficial trade between Tanzania and her neighbors has been on a growing trend. We can argue that information about the unofficial trade will strongly augment an analysis of comparative advantage, because estimates from national accounts which determine macro-economic policies normally omit unofficial cross-border trade and therefore can easily lead to faulty policy recommendations. Knowledge of the existence, scope, and nature of the unofficial cross-boarder trade can therefore provide important information needed in structuring support systems and infrastructure development programs to unlock the regional potentials.

Unofficial cross-border transactions involving food crops are common along the Tanzania/Kenya border (involving Arusha, Kilimanjaro and Mara regions) and the borders with Burundi (Kigoma region), Uganda (Kagera Region), and Zambia and Malawi (Mbeya region) (Ackello-Ogutu and Echessah, 1997). Food crops from Tanzania are usually exchanged against industrial consumer goods. This can be an early indication that Tanzania has comparative advantage or disadvantage in the production and export of agricultural and manufactured products. Empirical evidence by Ackello-Ogutu and Echessah (1997) shows that informal cross-border trade activities between Tanzania and the neighboring countries involve the exchange of large volumes of commodities. These range from agricultural food commodities mainly maize, rice,

beans, sugar, wheat flour, and root crops. Industrial commodities traded across the borders include toiletries, beers and spirits, cooking fats/oils, soft drinks, textile (both new and used), construction materials, etc.

It is important to remember that Tanzanian exports are mainly agricultural. Informal trade data with Kenya shows that Tanzania exported mainly agricultural food commodities. About 6,000MT of maize valued at about US$ 0.9 million, 2,000MT of beans valued at US$ 0.7 million, and about 900MT of rice valued at US$ 0.3 million were informally exported to Kenya in the year 1995/96.

Uganda is a good unofficial market of Tanzania's coffee. In 1995/96 coffee valued at US$ 1.1 million found its way to Uganda. Coffee represents over 48% of the estimated unofficial exports to Uganda. Other important agricultural exports to Uganda are rice, sugar, maize grain and maize flour, and bananas with a total value of US$1.0 million.

In the same period, it is estimated that Tanzania exported to Malawi 9MT of maize worth about US$ 1 million, 327MT of beans worth about US$ 117 million, and 7MT of rice. Trade with Malawi provides proof of the fact that movement of goods across neighboring countries is dictated by comparative advantages. The cool temperatures and the high elevation of southern highland regions of Tanzania, for example, are conducive for the production of beans and round potatoes. These commodities eventually find their way into Malawi. On the other hand, the soils of Malawi are relatively more suitable for the production of groundnuts than those in Tanzania, facilitating large exports of the crop to Mbeya in Tanzania.

Like Malawi, Zambia is also a net importer of such commodities from Tanzania. Exports to Zambia included over 6,000MT of Maize valued at US$ 1.2 million, over 1,000MT of beans worth US$ 1.2 million, over 1,000 MT of rice valued at 0.5 million, 400MT of wheat flour valued at US$ 0.2 million.

Congo is the largest informal trading partner of Tanzania. Over US$ 78 million worth of agricultural commodities (including fish) found their way to the Congo. This included over 4,000MT of wheat, 6,800MT of rice, 4,000MT of beans and 6,000MT of maize. It can not be easily ascertained that the flow of agricultural exports from Tanzania to Congo did not reach Rwanda and Burundi where information could not be

Table 1.2. Cross-Border Trade: Selected Tanzanian Exports

Agricultural Products		Countries					
		Kenya	Uganda	Zambia	Malawi	Zaire	Total
Maize	Qty	5,915	123	6,607	9	6,032	18,686
	Value	851	30	1,160	1	1,047	3,089
Beans	Qty	2,143	24	1,108	327	4,376	7,978
	Value	741	8	1,155	117	2,008	4,029
Rice	Qty	870	1,137	1,034	7	6,867	9,915
	Value	308	559	542	2	3,359	4,770
Coffee	Qty	-	-	-	-	-	-
	Value	-	1,117	-	-	-	1,117
Cotton	Qty	-	-	-	-	-	-
	Value	-	-	-	-	-	-
Wheat	Qty	-	190	407	2	4,402	5,001
	Value	-	132	227	1	2,942	3,302

Qty in Metric Tons, Value in ,000 US$
Source: Ackello-Ogutu and Echessah (1997).

collected due to the civil strife that prevailed in 1995/96. Rwanda and Burundi have a history of importing agricultural food commodities from Tanzania.

1.4 TANZANIA'S UNOFFICIAL CROSS-BORDER IMPORTS

A major observation regarding cross-border trade in Tanzania is that similar commodities could both be exported and imported. However, imports to Tanzania are mainly industrial. For example, wheat flour and sugar were major agricultural imports from Kenya. Over 1,200 MT of wheat valued at US$ 0.6 million was imported from Kenya. Significant imports from Kenya were however, as mentioned above, industrial commodities such as margarine, car and bicycle parts, sweets and biscuits, and salt all valued at about US$ 2.0 million. The direction and composition of trade between Kenya and Tanzania thus conforms to the belief that Kenya has a comparative advantage in industrial manufacturing, and its perennial food shortages make it a net importer of agricultural food commodities from its neighbors including Tanzania.

Uganda is basically a food self-sufficient country and hence a less important trading partner of Tanzania in agricultural commodities. Small volumes of beans and rice totaling 2MT valued at US$ 1,000 were imported from Uganda. It is worth mentioning that industrial commodities also dominate informal imports from Uganda. Amongst the leading industrial imports from Uganda are new textile valued at US$ 0.6 million and toiletry at US$ 0.5 million. Uganda is a net exporter of textile, toiletry, sweets and biscuits, and salt to Tanzania. This further augments the fact that Tanzania has a relative disadvantage in manufacturing industries. The commodities moving in opposite directions depend very much on the differences in agro-ecological and climatic conditions in southern Tanzania and Malawi. As explained earlier, it is only Malawi where we observe a significant flow of agricultural commodities to Tanzania.

Table 1.3. Cross-Border Trade: Selected Tanzanian Imports

Agricultural Products		Countries					
		Kenya	Uganda	Zambia	Malawi	Zaire	Total
Maize	Qty	-	-	-	284	-	284
	Value	-	-	-	39	-	39
Beans	Qty	-	2	-	7	-	7
	Value	-	1	-	3	-	3
Rice	Qty	19	2	-	323	-	323
	Value	11	1	-	186	-	186
Coffee	Qty	-	-	-	-	-	-
	Value	2	40	-	-	-	42
Cotton	Qty	-	-	-	-	-	-
	Value	-	-	-	-	-	-
Wheat	Qty	1,208	-	-	4	-	4
	Value	641	-	-	3	-	3

Qty in Metric Tons, Value in ,000 US$
Source: Ackello-Ogutu and Echessah (1997).

Table 1.4. Cross-Border Trade: Net Effect

Agricultural Product		Exports	Imports	Net
Maize	**Qty**	18,686	284	16,402
	Value	3,089	39	3,050
Beans	**Qty**	7,978	7	7,971
	Value	4,029	3	4,026
Rice	**Qty**	9,915	323	9,592
	Value	4,770	180	4,590
Coffee	**Qty**	-	-	-
	Value	1,117	42	1,075
Cotton	**Qty**	-	-	-
	Value	-	-	-
Wheat	**Qty**	5,001	4	4,997
	Value	3,302	3	3,299

Qty in Metric Tones, Value in ,000 US $.
Source: Ackello-Ogutu and Echessah (1997).

1.5 NET CROSS-BORDER TRADE

Table 1.4 presents estimates of net cross-border trade between Tanzania and her neighbors. According to the monitoring undertaken in 1995/96, it is indicative that Tanzania has a net benefit in the agricultural commodity trade with its neighbors. Both a combination of volume of traded and relative prices contribute to the positive net effect of cross-border trade to Tanzania. Largest net positive benefits are accrued in cross-border trade of Maize, Beans, Rice and Wheat, where each product contributes about US$ 4 million (Table 1.4).

Prices of the traded commodities fluctuate throughout the year. Import and export prices also vary. This variation emanates mainly from seasonality of production. It is notable however that the mean annual export prices for most of the selected crops, i.e., maize, beans, and wheat are higher than import prices for the same. This further explains the edge Tanzania has against its neighboring countries. Even crops that move in both directions (to and out of Tanzania) acquire higher prices in seasons that Tanzania is exporting.

Table 1.5. Cross-Border Trade: Prices of Selected Commodities

Product		Price Shs/Kg	Month Shs/Kg	Price	Month
Maize	Highest	128.3	May	79.3	March
	Lowest	70.8	August	52.0	June
	Mean	92.5		70.9	
Beans	Highest	274	March	400	Jan
	Lowest	162	June	130	May
	Mean	209		184	
Rice	Highest	318	Feb	360	Jan
	Lowest	262	Aug	180	April
	Mean	291		335	
Wheat	Highest	385	July	333	March
	Lowest	277	Feb	257	Sept
	Mean	347		293	

Source: Ackello-Ogutu and Echessah (1997).

2. Approach and Methods

In the 1980's Pearson devised the Policy Analysis Matrix (PAM) as a formal way to derive determinants of comparative economic advantage. It is typically organized as follows (Table 2.1). Several measures of economic efficiency can be explicitly traced to specific elements of the PAM. For this reason the PAM became a popular way of presenting policy-analysis and project-appraisal data (Byerlee, 1989; Nelson and Panggabean, 1991; Masters, 1994).

For the purpose of this study, domestic resource cost (DRC) has been adopted to measure the comparative economic advantage. DRC is an analytical tool for empirical evaluation of economic efficiency among alternative enterprises and is a commonly used criterion for measuring CEA. For any production option to be the most efficient user of the country's resources, two conditions need to be met: First, the foreign exchange cost of the domestically produced product must be less than its import price at the same foreign exchange value, i.e., the cost of producing the product domestically must be less than the cost of importing the same product. Secondly, the net foreign exchange gain from producing that product must exceed the net economic gain foregone from using the same amount of domestic resources to produce alternative products, i.e., the gains from using resources such as land, labor, capital, and water must be greater that the opportunity cost of using these resources in other production activities.[1]

A number of economic ratios can be derived from the PAM (Table 2.1). These economic ratios are more useful as indicators for the comparison of unlike outputs. Common measures directly calculated from the PAM table are as follows:

- Private Cost Ratio (PCR) = C / A - B
- Net Social Profit (NSP) = E - F - G = H
- Domestic Resource Cost Ratio (DRC) = G / E - F
- Nominal Protection Coefficient (NPC)
  - On tradable outputs (NPCO) = A/E
  - On tradable inputs (NPCI) = B/F
- Effective Protection Coefficient (EPC) = A - B / E - F
- Profitability Coefficient (PC) = (A-B-C)/(E-F-G) or = D/H
- Subsidy Ratio to Producers (SRP) = L/E or (D - H) / E
- Social Cost Benefit Ratio = (F + G) / E

In this study the Domestic Resource Cost Ratio,

Table 2.1. Measures of Economic Efficiency and Policy Distortions: The Policy Analysis Matrix (PAM)

Measure	Revenues	Tradable Inputs	Non-tradable domestic resources	Profits
1. Private prices	A	B	C	D
2. Social prices	E	F	G	H
3. Effects of divergences and efficient policy	I	J	K	L

Notes:
D = Private profits = A-B-C.
H = Social profits = E-F-G.
I = Output transfers = A - E.
J = Input transfers = B - F.
K = Factor transfers = C - G.
L = Net transfers = D - H or I - J - K.

Source: Adapted from Monke and Pearson (1989).

DRC generated from the PAM can be interpreted as shown in the equation below.

$$DRC = \frac{\text{Value-added domestically in terms of opportunity costs}}{\text{Value-added in border prices}}$$

The DRC can take on values equal to 1, >1, or <1. If DRC >1, then comparative disadvantage exists in that, since the DRC coefficient shows the domestic resource costs incurred per unit of foreign exchange earned or saved, the cost of producing a good domestically is greater than that associated with importing the good. If DRC <1, this implies a comparative advantage, since the good can generate foreign exchange at a lower resource cost than can direct purchase of foreign exchange.

Results obtained from DRC analysis offer useful information to policymakers in directing resources to their most productive use. It furthermore enables one to determine the contribution to net social gains and the economic efficiency of competing crops under various policy and technological scenarios.

Conceptually, the DRC is quite similar to effective protection. In fact the denominator is the same in the two measures. DRC differs from the EPC in that DRC does not consider domestic market prices to be a true reflection of opportunity costs. DRC will only equal EPC if (a) all goods are tradeables; (b) all prices reflect marginal rates of transformation of goods; and (c) there is a perfect competition in the domestic factor markets. Since these conditions are unlikely to be met in practice, however, we would expect divergence between DRC and EPC. A further distinction is that the numerator of the DRC is usually calculated not by subtracting tradable inputs (and the tradable components of non-traded inputs) from the domestic price, but rather by direct estimation of value-added by the primary factors.

Calculation of DRC is not problem-free. It uses only variable cost of production data. Ideally, stock of physical assets owned and an estimate of the value of that stock "used up" in the production process should be built into DRCs. In the absence of this knowledge about these fixed costs (and with the associated problem of how to allocate fixed costs among crops) the DRC estimates will be underestimated. Thus, estimates of DRC may better be treated as ranking of crops along a scale of comparative advantage, but the absolute levels should be interpreted as minimum estimates.

Another qualification along a similar line is that, from the standpoint of using DRCs as guides to allocation of resources at the margin, marginal costs are more relevant than average costs. With marginal costs, fixed costs do not play a role. But marginal costs will not equal average variable costs except under very special circumstances, so another element of uncertainty attaches to the estimates.

According to Hassan and Faki (1993), the major difficulty arising when using the DRC method is the valuing of inputs and outputs, especially when choosing the appropriate opportunity cost of both non-tradable and tradable. This difficulty is mainly due to the fact that, in the case of non-tradeables, no market for these resources exist, and in the case of tradeables the prices often do not correspond to their true economic value.

Several factors are likely to influence the measurement of the comparative advantage and must be taken into account (Appendix 1). The following convention was adopted to group commodities according to these factors:

1. As recommended by the joint study by the Project's Steering Committee in its meeting of June 1995 in Pretoria, the agro-ecological zonation approach has been used as the framework for classifying production environments according to biophysical conditions.
2. Differences within agro-ecological zones (AEZ) due to variations in technology, tenure, etc., have been captured by coding every production system as a distinct activity.
3. Variations in market and infrastructure factors are reflected in prices and transportation costs. These variations have been captured by defining a central market node for every commodity at which all trade will be assumed to take place. Consequently, prices and transport costs between these market centers

(nodes) reflect the opportunity cost of producing a commodity locally versus importing it from another region/zone or from another country.

4. Variations in resource endowments are reflected in the relative rental values of those resources in the different market centers.

5. Policy distortions are captured by measuring the divergence between market and social prices of goods and services on the input and product sides.

It is worthy to note the vastness and complexity of Tanzania in terms of climate, soils, and topography. A number of studies have attempted to classify the country into agro-economic zones (Samki and Harrop, 1984; LRDC, 1987). According to the LRDC classification, there are seven major agro-ecological zones: Coast, Arid lands, Semi-arid lands, Plateaux, Alluvial Plains, Southern and Western Highlands, Northern Highlands and isolated granitic mountains (Appendix 4). In terms of agricultural potential, the regions of Tanzania are divided into three broad categories: (1) high potential areas¾ the highlands, alluvial plains and plateau; (2) intermediate potential areas¾ coastal and semi-arid lands and (3) low potential areas¾ arid lands (ADIS, 1992).

The geographical location of the high potential areas in Tanzania far away from the port and main consumption area diminishes their expected high response to improved prices and marketing incentives. On the other hand, low potential areas may have been disadvantaged by the policy framework. Several places could fall under the same agro-ecological zone but differ in production system depending on interaction among climatic, soil, technical, economic, social, and cultural factors.

2.1 DESIGN OF THE EMPIRICAL STUDY AND ANALYSIS

Empirical case studies for a number of products were carried out and the PAM was used to analyze the extent of policy distortions and comparative advantage. The data was obtained from commodity chain studies and government official publications (MDB, various years). PAM analysis of the case studies was carried out as described below.

2.1.1 The Procedure Used to Compile Data for the PAMs

As pointed out above, the data from this study was obtained from commodity chain studies and secondary sources. The commodity chain studies involved the tracing of the commodity from production to the final consumption point. In doing so, all costs involved from production to marketing to processing to consumption are taken into account. The secondary data collected include standard coefficients, prices, and tax rates.

The data collected is entered in spreadsheet templates. There are five tables in total for each crop that need to be constructed. The first table provides calculations for the private and social prices of tractor/tillage. The second table calculates the private and social prices of inputs such as fertilizers. The third table calculates the private and social prices of the products or outputs. The fourth table provides estimates of revenues, costs and profits. The fifth table is the PAM results. These tables were constructed using Lotus 123 spreadsheets. A detailed description of how the PAM tables were constructed on a spreadsheet is provided below.

(a) Identify the major crops or commodities

Ideally each major zone and farming system could be represented by the important enterprises produced there. Furthermore, it is necessary to include under each enterprise any other variations based on location, enterprise size, and any other important variations. According to Appendices 2 and 3, however, the task of assembling such an amount of data so as to take into consideration all of the above variations would have been very costly indeed. Therefore, the crops studied were selected according to data availability within the time and cost dimension. Table 2.2 shows the enterprises that are considered in this study.

(b) Collect data on physical output and inputs, on a per hectare basis.

Data for the PAM is compiled on a per hectare basis. The physical output is equal to the yield per hectare. As yield is different from farm to farm and from year to year, the choice of yield is very important. An

Table 2.2. Location and Type of Agricultural Products Included in the Study

Agro-ecological zone	Important locations	Crop enterprise considered	Location of data sources	Technology in use	Farming system considered
Semi Arid lands	Dodoma, Singida, Northern Iringa and part of Arusha. Shinyanga. Morogoro except Kilombero, Wami basins & Uluguru mountains, Lindi and S.W. Mtwara	1. Cotton (WCGA)	Mwanza &Kahama	Hand hoe and oxen	Livestock, Sorghum & Millets - -
		2. Maize	Morogoro	Hand hoe	Maize/ legume
Northern highlands & isolated granitic mountains	Feet of mt. Kilimanjaro, & Meru, eastern rift valley extending to L. Eyasi Uluguru, Pare, Usambara, and Tarime	Northern Arabica Coffee	Kilimanjaro	Hand hoe	Coffee/ Banana/ Horticulture
South Western Highlands and Alluvial Plains	Broad ridge from northern Morogoro to north of L. Nyasa covering part of Iringa and Mbeya, Ufipa plateau, L Tanganyika shores and Kagera region Kilombero, Rufiji Usangu and Wami plains	1. Southern Arabica Coffee	Mbozi	Hand hoe	Maize/legume
		2. Maize	Mbinga	Hand hoe	Coffee/ Banana/ Horticulture
		3. Paddy/rice	Morogoro	Hand hoe	Paddy/rice, sugar cane

average yield for each particular crop was determined.

Inputs were classified into three categories: materials, labor, and land. Material inputs include tractor services, tillage, fertilizers, pesticides, seeds, irrigation, and other items that are not covered by the previous items. The other items can include small farm tools and various surcharges imposed by central and local governments or any other miscellaneous items. Labor includes hired and family labor.

(c) Collect data on prices of the product and inputs

Once the physical amounts of output and inputs are estimated, the revenues and costs can be calculated with their respective prices. For each individual output or input item, there are two different prices: private and social. These are discussed below.

* Private and social prices for the product

The private and social prices are the import parity price if it is a net importing crop, or the export parity price if it is a net exporting crop.

* Private and social prices for tractors and tillage

Tractors and tillage services are the main capital inputs involving a significant proportion of imported materials.

* Private and social prices for fertilizers

Fertilizers are the main current material inputs. They also involve a large proportion of imported materials.

* Other material inputs

Prices of other material inputs were estimated by the analysts. The accuracy of estimation depends on data availability and the judgement of the analysts.

* Private and social prices for labor

If labor is hired, the actual wage rate is the private price. If it is family labor, the private price may be different from the prevailing wage rate. The private price should be the opportunity cost of family labor. In theory, the opportunity cost of family labor should be equal to the wage rate of the best alternative employment opportunity apart from farming. As this opportunity cost is usually very difficult to measure, one may like to treat family labor the same way as hired labor. In other words, for simplicity reasons, the prevailing wage rate could be used as a proxy for the private price of family labor.

The social price of labor may be different from the actual wage rates. In theory, it should be equal to the value of marginal product of labor (VMP_L). It may be very difficult to estimate VMP_L. In this study, we use the approach recommended in Yao (1993). Labor is divided into peak-season and off-peak season components. The wage rate in the peak-season is regarded as the opportunity cost of labor for that period. The opportunity cost of labor during the off-peak season is only half of the prevailing wage rate. Thus, the social price of labor can be calculated according to the following formula.

$$SP_L = \frac{W_p + 0.5\, W_o}{2}$$

Where SP_L = social price of labor. W_p and W_o are the prevailing wage rates in the peak and off-peak seasons, respectively.

* The private and social prices for land

The social price of land is the opportunity cost of land measured in foreign exchange. Measuring the opportunity cost of land is probably the most difficult task in constructing a PAM. Most people tend to take the net return of a competing enterprise as the opportunity cost of land for the crop under study. Net return in this case is defined as the profit (revenue - cost of materials - cost of labor and other charges) per acre of land. For example, if we want to construct a PAM for rice, we need to know the opportunity cost of land for rice. The opportunity cost of land for rice is usually taken as the net return to land for the production of the major competing crop. Assuming that maize is a major competing enterprise for rice in Morogoro and the net return to maize production is Shs 15,000 per hectare, we can say that the opportunity cost of land for rice production is 15,000.

In reality, it is not easy to identify a major competing enterprise for every crop. For example, if paddy is grown in a very exclusive area, it is difficult to calculate the opportunity cost of land for rice production. In this case, some arbitrary methods may have to be used. Some possible estimates may include land rent or the land opportunity cost of other similar crops.

In this study, we assume that the opportunity cost of land is the net return of a competing enterprise. The private price of land is similar to the social price but the former has to take land tax and foreign exchange distortion into account.

(d) Separate inputs into tradable and non-tradable components

As the costs of production are separated into tradable and non-tradable components, every item has to be divided into two parts. Some items have a greater proportion of tradable elements than others. For example, labor and land are typically regarded as 100 percent non-tradable. Material inputs, such as tractor services and fertilizers, tend to have a significant proportion of tradable elements.

For other input items, the proportions of these two different components are estimated on an ad hoc basis. These proportions are presented in the revenue, cost, and profit table for each crop.

(e) Revenues, costs, and profits

Once all the above estimations are completed, it is possible to construct a revenue, cost, and profit table for the crop. This is illustrated in the case studies.

2.1.2 Data Analysis

(a) Construct a PAM

The five tables referred to in Section 2.1 are linked together in the spreadsheet. Values in the PAM table are derived from the revenues, costs, and profits calculated in Section 2.1.1(e).

(b) Economic measures derived from the PAM - NPC, EPC, and DRC

Once a PAM is constructed, the computer software package, Lotus 123, automatically calculates values for NPC, EPC, DRC, and other measures as detailed above.

3. Description of the Farming Systems

3.1 MAIZE AND LEGUMES FARMING SYSTEM

Maize and legumes farming system represents the largest number of smallholder (which also characterizes agricultural production in Tanzania). It characterizes the western plateau and southwestern highlands. Use of fertilizer is common whereas the use of draught power is limited.

This agro-ecological zone is included in this study to reflect important characteristics of the four large maize surplus producing regions in the southern highlands of Tanzania, Iringa, Mbeya, Rukwa and Ruvuma. Coincidentally, this area is geographically closer to Zambia and Malawi and hence giving great possibilities for cross-border trade and better comparative assessment with what is happening across the border. Generally, the area is located at an altitude of between 800 and 1,500 meters above sea level. Rainfall is not in short supply (Table 3.1) and soils are generally good loams. Clay soils of moderate fertility are found in the south whereas in the north infertile sands predominate. Arguably, the fertility of the sandy loams are thought to be declining due to over cultivation and reduction in fallow periods. Rainfall is largely unimodal and generally reliable with little inter-annual variations. It is almost always over 1,000 mm per annum, most of which occurs between November and May.

Predominance of maize cultivation is the defining feature of the agro-ecological zone, generally grown in pure stands although interplanting with beans, groundnuts and other legumes is not uncommon. Smallholders produce maize with medium technology. Mechanization is limited, although the use of draught power is increasing. Short fallow periods are used as a measure for conserving soil fertility in some parts of the area, although in others this is not possible such that continuos cultivation has depleted soil fertility which necessarily has to be compensated by inorganic fertilizers, without which maize production fails. This makes some parts of this area high input zones. Other crops grown are coffee, pyrethrum, tobacco, tea, and legumes. Potatoes and wheat are produced in much higher altitudes. Coffee and tobacco are generally produced at smallholder levels. However, there are a limited number of coffee and tobacco estates.

Maize yields have been found to be in the range of 0.25/ha in a bad year to 2.5/ha tones in a good year. However, on the average, farmers obtain about 1.5 tones/ha. This compares quite unfavorably with the potential yields of the different varieties grown in the zone. Secondary sources show that using a 10-year average in this zone can yield an average of 7.6, 7.4, and 6.7 tons for H6302, H614 and TMV-2 varieties respectively. In mid-altitude areas the H632, Kilima, TMV-1, and UCA varieties can yield an average of 3.9, 4.6, 4.5, and 4.2 tons respectively. Use of improved seeds is declining due to the relatively high prices, and

Table 3.1. Average Amount of Rainfall at Mbeya

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	-	-	-	1105	808	1067	1177	701
days	88	101	90	102	87	90	110	82

Source: Ministry of Agriculture and Co-operatives, 1993

thus farmers are increasingly using seeds from previous crop. Maize seed price range from Shs 6,500 per 10kg bag in the case of Ukiriguru composite to Shs 11,000 per 10kg bag for C4141 (Turuka 1995).

Beans are grown in most of these areas and the yield levels are about 0.4 to 0.5 tones/ha. Yield varies with variety grown. There is little use of improved bean varieties that are also high yielding and disease resistant. This seems to have been due to high seed prices. For example, the Kablanket varieties sell at Shs 30,000 per bag (100 kg). Cross-border trade and inter-regional trade in beans are practiced.

Although farmers are still growing maize, secondary sources indicate that there has been a sharp decline in the use of fertilizer. In most cases this has taken the form of low rates of application, i.e., below the recommended rates or no application at all.[2] This is largely due to decreased profitability in its application on maize. The decrease in profitability is partly explained by low prices received from private traders buying maize from the area, in addition to failure of the same to buy the crop. For example, fertilizer prices are in the range of Shs 7,000 for Calcium Ammonium Nitrate (CAN) and Shs 14,500 in the case of NPK. Use of manure is limited due to availability as well as transport costs in areas where availability is not a problem.

Fertilizer and other agro-chemicals are now competitively supplied by both private and public sector institutions in the area. The key players are Tanzania Fertilizer Company (TFC), Tanganyika Farmers' Association (TFA), Southern Highlands Farmers' Association (SHIFA), and Triachem and Mohamed Enterprises.

Freight charges differ between tarmac and other roads, with and without return load, the type of goods transported, as well as between parastatal and private companies. Using parastatal companies data, the freight charges were found to be as follows for 1994/95 season. In tarmac roads without return load the charge is Shs 32/km whereas with a return load the charge is Shs 46/km. In other roads (un-bitumenised roads) with a return load, it costs about Shs 52/km whereas without return load it is about shs.38/km. Private fertilizer distributors reported the rate of Shs 55/km (without specifying road type or whether this applied to with or without return load situation). The new freight charges that came into effect as from July 1, 1996 as reported by a parastatal transport company are summarized in Table 3.2.

Table 3.2. Mbeya Region Transport Company Freight Rates for 1996/97 Season

Destination	Freight rate Shs/km/ton
Within region (one way)	95
Within region (two ways)	68
Outside region (one way)	83
Outside region (two way)	53
Outside region (DSM route one way)	70
Outside region (DSM route two way)	35

Source: Survey data

3.2 WETLAND PADDY AND SUGAR CANE FARMING SYSTEM

This system is practiced in river valleys and alluvial plains with permanent water supply. Simple irrigation technology is applied and furrow irrigation is the predominant water supply technique to the fields. Crops grown in the area include sugar cane, paddy, maize, cotton, and cassava (in upland rather than river valleys). Purchased production inputs used are seeds, fertilizer, and herbicides. Price for the various inputs used in the 1995/96 are summarized in Table 3.3. Also note that the use of herbicides is very common in paddy and sugar cane production.

Input distribution and retailing is carried out largely by the private sector. Although a number of stores and shops were reported to deal with input retailing, only few retailers could be considered to be main retailers. In this farming system the yield levels for various crops grown are shown in Table 3.4. In that season, average producer prices and the average amount of output produced are also shown in Table 3.4.

Table 3.3. Mbeya: Input Prices for 1995/96 Cropping Season

Inputs	Unit	Price, Shs
Maize seeds (staha)	kg	485
Cotton seed	kg	free
Sorghum seeds	kg	450
Sunflower seeds	kg	370
Beans seeds	kg	620
Onions seeds	kg	12,000
Herbicide (2-4 D)	liter	5,000
Fertilizer (SA)	bag	8,000
Fertilizer (urea)	bag	13,500
Blue copper	kg	5,000
Decis ULV	liter	4,500

Source: Survey data

Table 3.4. Mbeya: Average Yield Levels and Output Prices, 1995/96

Output	Yield (kg/ha)	Unit of sell	Average Price (Shs/unit)
Maize	2,000	bag	9,200
Sorghum	1,200	bag	6,500
Paddy	2,500	bag	7,500
Sunflower	370	kg	100
Cotton	1,200	kg	160
Sugar cane	30,000	ton*	8,000

* Refers to raw sugarcane with 10% recoverable sucrose.
Source: Survey data

Although large-scale paddy production is present under National Food Company (NAFCO), the production is generally dominated by the small-scale farmers. Large-scale paddy production largely involves the use of irrigation water whereas the small-scale production depends heavily on rainfall or traditional irrigation systems where production is in lowlands. Five regions, namely Shinyanga, Mwanza, Morogoro, Mbeya, and Tabora, are the major producers.[3] Where rainfall is the dominant source of water supply, paddy production has also varied a great deal in such areas. Generally, the use of purchased inputs (especially fertilizers and herbicides) seems to have decreased under smallholder farming, and labor demands are generally high particularly for weeding and harvesting tasks.

Small-scale trading dominates paddy as well as marketing from production points to consumption points. Local traders buy small quantities of paddy and transport it to mills where it can be traded inter-regionally. Most of the trade routes end up in Dar es Salaam or Zanzibar.

Rice imports and exports are not uncommon either and it is usually in commercial (private sector enterprises) or aid form. Although there seems to be some incentives in paddy production in the non-remote major producing areas, the influx of cheap rice imports from South East Asia (both commercial and aid) may have been a disincentive to local producers. Exports (both official and unofficial) occur in most cases along the border regions of the Southern Highlands and Western zone of Tanzania.

3.3 COTTON, PADDY, SORGHUM AND MILLET, AND LIVESTOCK PRODUCTION SYSTEM

This farming system is located in the north (Shinyanga and Mwanza regions). The area, lying at an altitude of about 1,000 and 1,500 meters, has gently undulating plains with some rocky hills and escarpments. It is dominated by what is commonly known as Sukumaland in Tanzania. In the uplands the soils are well drained; in the lowlands there are areas of black, alluvial cracking soils (black cotton soils) with moderate soil fertility, suited to paddy production. There is some soil erosion on the slopes where soils are generally poor. Cotton, maize, cassava, groundnuts, and sweet potatoes are suited to the upland soils. The rainfall pattern is bi-

Table 3.5. Average Amount of Rainfall of Mwanza

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	857	7,001	951	1,013	1,152	1,475	1,238	1,417
days	74	68	75	91	78	125	103	97

Source: Ministry of Agriculture and Co-operatives, 1993

modal, extending from October to May with most of the rain falling in November-December and March-April. The mean annual rainfall ranges between 800 and 900 mm (Table 3.5). While food production is still based on the drought resistant cereals (i.e., sorghum and millet), farmers also produce cotton, oilseeds, maize, and paddy for the market.

Apart from crop production, livestock play an important role in the farming system. Cattle are the most important livestock kept by people in this agro-ecological zone. Cattle use ranges from a source of draught power to bride price to means of savings. Animal manure helps to maintain soil fertility of farm plots close to homesteads. Ownership is skewed with few households owning a large share of cattle relative to others.

Cotton, unlike other traditional crops, is a smallholder crop with virtually no estate type of production. Geographically, production is divided into Eastern and Western growing areas and is highly dependent on rainfall. Traditionally, no fertilizer is applied on cotton but vast amounts of pesticides are used. The average yield level is about 400-500 kg/ha (Table 3.6). This compares quite unfavorably to yield levels in other countries of SADC region and other parts of Africa. Yields of up to 2,000 kg/ha have been recorded in Zimbabwe, Mali, Sudan, and Egypt.

Although cotton production has been an important undertaking in some of these areas, serious problems seem to have affected its production. Problems facing the industry include lack of buyers, high cost of production inputs, low ginning capacity, and low consumption rates of the domestic textile factories. Whereas low quality seeds and used, inadequate application of inputs and pesticides results into poor yields, transportation, storage, and low ginning capacity are among problems experienced during bumper harvest. Manage-

Table 3.6. Average Crop Yield Levels under Different Technology Levels During 1994/95 Cropping Season (kg/ha)

Crop	Technology			
	Hand hoe	Oxen	Improved (own oxen)	Improved (hired oxen)
Maize*	400	500	800	1,000
Maize**	300	400	700	n.a.
Maize***	220	300	n.a.	n.a.
Groundnuts**	60	100	150	n.a.
Paddy*	1,000	1,100	1,500	1,500
Sorghum***	250	300	n.a.	n.a.
Cotton	400	450	750	1,100

* Pure stand. ** Maize and groundnuts intercrop.
*** Maize and sorghum intercrop. n.a. not available.

Source: Survey data

Table 3.7. Average Cost of Purchased Cotton Inputs 1992/93 to 1994/95 Production Seasons

Input	Unit	Price per Unit 1992/93	Price per Unit 1993/94	Price per Unit 1994/95
Fertilizers (SA)	bag	2,006	6,414	n.a.
Fertilizer (TSP)	bag	3,407	13,562	n.a.
Pesticides*	liter	1,476	1,800	n.a.
Batteries	set of 8	1,200	2,400	n.a.
Piece of Cloth	pieces	1,500	1,500	n.a.
Pesticides**	100 gm	n.a.	1,200	2,000
Seeds***	kg	n.a.	800	1,200

* Thiodan ** Actellic 100 gm sachets.
*** Maize seeds. n.a. not available.

Source: Survey data

ment problems of the marketing institutions are also present. In recent years, the average prices of farm inputs have been increasing substantially, partly due to the removal of input subsidies (Table 3.7).

3.4 COFFEE, BANANA, HORTICULTURE AND DAIRY FARMING SYSTEM

Predominantly this zone is located in volcanic uplands with soils derived from volcanic lava and ash. The soils on the slopes are generally fertile and can support intensive cultivation. The population also cultivates land in the lower altitudes, commonly known as *porini*, where maize, beans, and sunflower are grown. The lowland soils are also of volcanic origin but highly susceptible to erosion and over-cultivation.

The annual rainfall pattern is bimodal with short rains from November to January and long rains from March to June. On the mountain slopes, where much of the coffee is grown, the rainfall is very reliable. On the lowlands on the other hand, rainfall is more variable and although the cropping areas are not drought prone, low rainfall can affect crop yields. Table 3.8 depicts the annual total rainfall as measured in Moshi. On the middle and upper slopes, rainfall is between 1,000 and 2,000mm per year.

Crop production is well integrated with livestock production as most households keep stall-fed cattle using crop residues and pasture produced by the household. The manure from cattle pens is used to fertilize coffee and banana plots (which normally surround or are close to homesteads). Only in rare occasions is manure transported to fields in the lowlands. Almost 75% of the households keep cattle, and they are kept

Table 3.8. Average Amount of Rainfall at Moshi

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	709.5	1,004.3	913.3	1,085.0	438.9	1,075.2	789.8	1,308.3
days	57	68	70	86	46	85	75	82

Source: Ministry of Agriculture and Co-operatives, 1993

Table 3.9. Average Coffee Yields under Different Production Regimes

Area	Family Labor	Family and Hired labor
Mbozi	660	n.a.
Mbinga	650	650
Kilimanjaro*	370	370
Arusha*	370	370
Kagera*	300	n.a.
Mbozi	660	n.a.

* Usually coffee is intercropped with bananas. The average banana yield for Kilimanjaro and Arusha is about 500 bunches. In Kagera, the average banana yield is 600 bunches.

n.a. not available.

Source: Survey data

largely for milk production and manure. Milk production is both for sale and household consumption.

Production is based on perennial shrub and tree crops, of which coffee and bananas are often inter-cropped. In some areas, tea is grown (Rungwe district). Cereals and pulses are inter-cropped on separate lands. Land is scarce under this system and thus there is very little fallow practiced while fertility is maintained with mulch from crop residues and manure from dairy cattle. Rainfall is fairly high, and high value flowers and vegetables are produced where linkages to markets are available. This system is practiced in densely populated highland areas in Kilimanjaro and Arusha. Other areas are Matengo highlands in Ruvuma, Usambara mountain ranges in Tanga, and the Highlands of Mbeya and Kagera regions.

Production is predominantly carried out by smallholder producers although large-scale farmers are also involved (both private and public sector). The types of coffee produced are predominantly mild arabica, that is produced in the Southern Highlands and Northern zone and robusta coffee that is grown in the Western zone. Available evidence shows that of the total coffee produced, about 72% is mild arabica, followed by 20% robusta coffee and only a small share (8%) consists of hard arabica coffee.

Noteworthy is the fact that although the area under coffee appears to have increased over the last twenty years, (largely in the Southern Highlands rather than the dominant traditional production areas of the northern zone), the amount of coffee produced has remained more or less stable. Evidence also shows that yields have been declining during the past 15 years. The current yield levels for the different production areas are shown in Table 3.9 under the smallholder production system. Under the estate sector, there is a huge difference in yield levels. For example, statistics for 1993/94 show that the average yield was 305kg/ha, 581kg/ha, and 46kg/ha for privately-owned, Kilimanjaro Native Co-operative Union (KNCU), and public sector estates respectively. The average yield levels for other crops grown are as shown in Table 3.10.

Although much of the cause for the declining yield is related to diseases, aging coffee trees (especially in the northern zone), unavailability of labor, inadequate supply of seasonal inputs such as fertilizer and other agro-chemicals, the central problem seems to lie in the eroded profitability in coffee production precipitated by declined yields due to increased cost of production. Not only has the yield level declined but also the quality of coffee produced has deteriorated. It is argued that the proportion of coffee in the top five classes is currently less than 1%, which is a big drop from about 16% attained some 20 years ago. Table 3.11 shows the price level of inputs used in coffee production and other crops in the farming system.

Table 3.10. Average Crop Yield Levels

Crop	Yield (kg/ha)
Tea*	2,500
Maize	1,500
Sorghum	480
Sunflower	780
Beans	600

* Green leaf yield per hectare.

Source: Survey data

In areas where coffee (arabica) is grown, fertilizer application is also limited compared to the situation before fertilizer subsidies were still in place. The same applies to the application of other agro-chemicals such as pesticides, fungicides, and herbicides. Arguably, this has been due to higher prices for the seasonal inputs and lack of production credit. Average coffee yields range between 430kg and 475kg and the average prices received have been in the range of Shs 650 and Shs 800 per kg during 1996/97 buying season.

Table 3.11. Input Prices During 1995/96 and 1996/97 Season

Input	Unit	Price 1995/96	Price 1996/97
Fertilizer (SA)	bag	7,500	n.a.
Fertilizer (NPK)*	bag	10,500	
Pesticides:			
Dursban	liter	9,200	8,500
Blue copper	kg	3,200	2,500
Red copper	kg	2,600	2,600
Seeds**	kg	6,000-7,000	12,000

* Used also in tea production. ** Maize seeds.
n.a. not available.

Source: Survey data

Under the new arrangements, the key players in the coffee industry are co-operative unions: Tanzania Coffee Board (TCB), private traders, farmers, coffee curing plants, and the government. The major changes relevant to this study includes abolishment of pooling system in which case TCB kept the accounts for all co-operative unions and then distributing proceeds from coffee sales to the primary co-operative societies. It also arranged the advance payment for farmers. With the reforms in the marketing arrangements, the co-operatives are now responsible for making payments to the primary co-operative societies and then to farmers while private trader payments are made directly to farmers.

Coffee is sold on auction floors (to all buyers) which are held weekly or twice a week depending on the season. Licensed buyers are free to do their own quality tests, although Liquoring Department of the Tanzania Coffee Board conducts such tests and make the results available to all licensed buyers before the auction begins. The coffee processing sector consists of five major factories located in Moshi, Mbozi, Mbinga and Bukobaing. The processing capacity is adequate except for the Bukoba plants that require rehabilitation due to old age.

Tanzania Coffee Board is the marketing agent for only few co-operative unions. The government no longer announces advance payments to be made by the unions to the farmers. It is left to the union to determine the payments. With the co-operative unions given the mandate to determine the advance payments payable to the farmers, differential final payment payable to farmers has also been common. Some of the co-operative unions have completely failed to effect the final payments. This is reflected by farmers rejecting to sell coffee to their co-operative unions in the following season, increasing the number of farmers selling coffee to the private sector. This has resulted in differences in the amount received by the farmers in different production areas. The trade in agricultural inputs (which was the reserve of the Tanzania Coffee Marketing Board and at times Co-operative Unions) has also been liberalized since 1991/92 season.

3.5 MAIZE/LEGUMES-TOBACCO SYSTEM

The maize legumes system covers a large part of Tanzania, including areas from Kagera (bordering Uganda) running through a large part of Tabora region (western Tanzania) to Ruvuma (bordering Mozambique). It is one of the largest agro-ecological zones and is thought to accommodate about 36% of the rural population of Tanzania.

Much of this agro-ecological zone lies on the wide plains of the Western plateau at an altitude of between 1,100 and 1,300 meters above sea level. The topography is fairly uniform with gently undulating plains intersected by seasonally flooded valley bottoms. A wide variety of rainfall and soil types are to be found within

Table 3.12. Average Amount of Rainfall of Tabora

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	-	-	-	1,131	872	1,093	909	1,338
days	70	90	86	95	74	93	92	80

Source: Ministry of Agriculture and Co-operatives, 1993

the system. Although rainfall patterns are extremely variable and unpredictable, research has shown that rainfall in the wetter areas of this zone is more reliable. Table 3.12 depicts the rainfall pattern in one of the areas in this agro-ecological zone. Vegetation on the uplands is primarily Miombo woodlands whilst on the lowlands it can range from wooded grasslands to swamp, depending on the drainage conditions. Soils are predominantly sandy-loams on the upland with clay or sandy-clay on the valley bottoms. Much of the soils in these areas have been classified to have low fertility.

The main crops in this area are maize, rice tobacco, cassava, groundnuts, beans, and sorghum. Tsetse infestation precludes livestock production activities and in recent years livestock keepers have migrated to the southern parts of Tanzania.

3.6 AGRO-PASTORAL PRODUCTION SYSTEM

This area is largely located in the central parts of Tanzania that are essentially semi-arid areas. The agro-ecological zone also includes southern and western parts of Arusha and Tanga region respectively. Western and northern parts of Morogoro and Iringa regions are a part of this agro-ecological zone. Typically this is made up of an undulating plain with rocky hills and escarpments. The altitude ranges from 1,000 to 1,500 meters. In the plains, the soils are sandy/loams, well drained, but with low fertility. The rainfall pattern is unimodal and highly unreliable with an average of between 500mm and 800mm (Table 3.13).

Over the entire zone rainfall tends to be unreliable and almost all areas are drought prone. The main rainy season is from December to March with between 70 and 90 days of rain per year. The main crops produced in this zone are sorghum, maize, finger millet, and groundnuts. Other food crops produced include bambara nuts and cassava. The main cash crops are grapes, grown by very few households partly due to the high initial investment requirements. Livestock keeping is an important activity in the area, with cattle and small ruminants forming a higher proportion of stocks kept by households. In recent years, livestock keepers have shown a tendency to migrate to other parts of the

Table 3.13. Average Amount of Rainfall of Dodoma

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	-	-	-	475	743	534	842	501
days	43	50	43	46	42	42	57	39

Source: Ministry of Agriculture and Co-operatives, 1993

country in search of pasture and water.

3.7 CASSAVA-CASHEW/COCONUT PRODUCTION SYSTEM

The study zone is an important cashew producing area. Other crops produced are cassava and coconut with a bit of paddy. This agro-ecological zone extends more or less along the coast of mainland Tanzania as well as the lakeshore areas of Mwanza, Mara, and Kigoma. It is characterized by infertile sands and relatively poor rainfall that make it unsuitable for maize production. Cassava is therefore the main food crop, often grown in association with cashew or coconut with which it is commonly interplanted in addition to being mono-cropped. Cashew is the main cash crop. Concentration on cassava and cashew arises out of the combination of a high population density and a situation of extreme geographical isolation in addition to agro-ecological conditions. For example, the road from Mtwara to Dar es Salaam is closed almost half of the year due to flooding of the Rufiji river, while the road from Songea to Mtwara is also impassable for long periods during the wet season. There is also increasing evidence of the existence of informal cross-border trade between Mozambique and Tanzania.

Much of this zone lies at an average altitude of less than 300 meters. In general, the soils are infertile sands, although there are significant areas of more fertile clays on the raised areas and river flood plains. Specialized bush fallow systems have evolved as a result, although population pressures and the difficulties of land clearing have led to a severe shortening of fallow periods. Around settled areas cassava is cultivated on virtually permanent basis with important consequences for soil fertility. Where much of the cashew and cassava is cultivated, the rainfall pattern is usually unimodal, mainly falling during December to April. Annual rainfall is between 800mm to 1,200mm and is usually unreliable (Table 3.14). Seasonal interruptions in rainfall are not uncommon, however, and heavy flooding can occur.

Table 3.14. Average Amount of Rainfall of Mtwara

Year	1983	1984	1985	1986	1987	1988	1989	1990
millimeters	-	-	-	1376	970	1,007	1,312	915
days	88	94	83	97	67	77	109	64

Source: Ministry of Agriculture and Co-operatives, 1993

4. Results and Discussion

In order to help understand the process of calculations and estimations that were undertaken in the Lotus 123 spreadsheets. There are five standard tables that were constructed for each product. Each table will be given a detailed explanation using rice as an example.

4.1 THE PAM RESULTS

The products for which data was adequately collected for the PAM analysis are shown in Table 2.2.

4.1.1 An Illustration for the Case of Rice[4]

(1) Explanation for Table 4.1 (Private and Social Prices of Tractor/Tillage)

- The objective of this table is to calculate the hourly cost of tractor (tillage) services and derive the tradable and non-tradable proportions of this cost.
- Tractors (tillers) in Tanzania are imported. Thus the relevant prices are import parity prices of tractors (tillers).
- The hourly cost of tractor (tillage) services is divided into fixed cost and variable cost.
- Fixed costs are calculated at the top part of the table. It starts from the import prices at the border. The border price is measured in terms of US dollars. To convert it into local currency, it has to be multiplied by the exchange rate (A3 = A1 x A2). The first divergence between the social and private prices starts from here. The private price takes the official exchange rate. The social price takes the shadow exchange rate.
- The border price is not the price paid by the producers. The actual price should include port charges, taxes (surcharges), and a mark-up of the importers (A = A3 + A4 + A5 + A6 + A7). A6 is a tax element that does not add to the social price although it has to be included in the private price. This is the second point where private and social prices diverge.
- To convert the purchase price into hourly cost, we need to calculate the difference between the total value and the salvage value (A10 = A8 – A9). This becomes the actual cost to be accounted for production. It is also necessary to estimate the length of life of the tractor and the number of hours it can service each year (A11 and A13). With A10, A11, and A13, we can calculate the average hourly depreciation cost [A14 = A10 / (A11 x A13)]. The total fixed cost must also include interest charges. To calculate the interest charge, we need to derive the average borrowing requirement that is roughly equal to half of the initial capital value including salvage value. We also need to know the average interest rate for the capital. Thus the hourly interest charge is calculated as {A15 = 0.5 x [A8 x A12 / (A11 x A13)]}. The total hourly fixed costs is equal to the sum of A14 and A15 (A16 = A14 + A15).
- The variable cost includes consumption of fuel, engine oil, repair, and labor (B8 = B3 +...+ B7).
- The grand total hourly cost is equal to the sum of hourly fixed cost and variable cost (C = A16 + B8).
- After the total hourly cost is calculated, we calculate the proportions of tradable and non-tradable share.

  The tradable elements include depreciation (A14), fuel, and mobile oil costs (B4 + B5). Thus the tradable share [D = (A14 + B4 + B5) / C].

  The non-traded elements include interest charges, repair labor, insurance and tax costs. Thus the non-tradable share [E = (A15 + B3 + B6 + B7) / C or E

Table 4.1. Morogoro Rice. Private and Social Prices for Tractors/Tillage (1994/95)

	Tractor		Tillage	
A Fixed Cost	**Private**	**Social**	**Private**	**Social**
1 CIF Dar es Salaam [$]	32,349	32,349	6,470	6,470
2 Exchange Rates [Shs/US$]	540.70	550.62	540.70	550.62
3 CIF Cost [Shs]	17,491,104	17,812,006	3,498,221	3,562,401
4 Port Charges [*5%]	874,555	890,600	174,911	178,120
5 Purchase Price [Shs]	18,365,660	18,702,607	3,673,132	3,740,521
6 Surcharge @ 10%	1,836,566	0	0	0
7 Mark-up @ 10%	1,836,566	1,870,261	0	374,052
8 Total Price [Shs]	22,038,791	20,572,867	3,673,132	4,114,573
9 Salvage value (10%)	2,203,879	2,057,287	367,313	411,457
10 Initial capital cost	19,834,912	18,515,581	3,305,819	3,703,116
11 Use life (years)	10	10	15	15
12 Rate Of Interest	0.31	0.31	0.31	0.31
13 Hours Per Year	1,000	1,000	250	250
14 Depreciation [Shs/hr]	1983.49	1851.56	881.55	987.50
15 Capital Cost [Shs/hr]	3,416.01	3,188.79	2,277.34	2,551.04
16 Total cost [Shs/hr]	5,399.50	5,040.35	3,158.89	3,538.53
B Variable Costs				
1 Repair Cost Coefficient	0.05	0.05	0.05	0.05
2 Repair Cost [Shs/year]	1,101,940	1,028,643	183,657	205,729
3 Repair cost [Shs/hr]	1,101.94	1,028.64	734.63	822.91
6 Fuel Cost (Shs/hr)	14.30	6.57	0	0
9 Lubricants (oil) (Shs/hr)	5.72	3.70	0	0
10 Labor (Shs/hr)	23.83	23.83	0	0
11 Insurance/tax (Shs/hr)	2.9	0	0	0
13 Total (Shs/hr)	1,148.69	1,062.74	734.63	822.91
C Grand total cost (Shs/hr)	6,548.19	6,103.10	3,893.52	4,361.45
D Traded proportion	0.52	0.52	0.58	0.58
E Non-traded proportion	0.48	0.48	0.42	0.42

Notes:
(1) It is assumed that traded elements include total fixed cost, fuel, and mobile oil costs.
(2) Non-traded proportion includes repair, labor, insurance, and tax costs.

= 1 – D].

(2) Explanation for Table 4.2 (Private and Social Prices of Fertilizers and Other Inputs)

- The objective of Table 4.2 is to derive the private and social prices of different fertilizers on a per kg basis. The shares of tradable and non-tradable are also estimated.
- Again, Tanzania is a net importer of fertilizers. The relevant prices to be estimated are import parity prices.

Table 4.2. Morogoro Rice. Private and Social Prices of Fertilizers (1994/95)

	UREA		DAP		NP		Pesticides	
	Private	Social	Private	Social	Private	Social	Private	Social
Exchange Rate (Shs/$)	540.7	550.62	540.7	550.62	540.7	550.62	540.7	550.62
1 FOB: Port Of Origin $/T	0	0	0	0	0	0	0	0
2 Insurance & Freight $/T	0	0	0	0	0	0	0	0
3 CIF Dar es Salaam [$/T]	163	163	0	0	0	0	0	0
4 CIF Dar es Salaam [Shs/T]	88,134	89,751	0	0	0	0	0	0
5 Unloading	1,300	1,300	0	0	0	0	0	0
6 Port Handling	3,460	3,460	0	0	0	0	0	0
7 Warehouse Cost	1,920	1,920	0	0	0	0	0	0
8 Transportation*	3,780	1,890	0	0	0	0	0	0
9 Marketing Margins	1,700	1,700	0	0	0	0	0	0
10 Domestic Value	100,294	100,021	0	0	0	0	0	0
11 Less Subsidy**	0	0	0	0	0	0	0	0
12 Domestic Price	100,294	100,021	0	0	0	0	0	0
13 Transport to Farmgate	9,200	4,600	0	0	0	0	0	0
14 Price at Farmgate (Shs/T)	109,494	104,621	0	0	0	0	0	0
15 Price per KG	109.49	104.62	0.00	0.00	0.00	0.00	0.00	0.00
16 Price/Kg (pure contents)	238.03	227.44	0.00	0.00	0.00	0.00	0.00	0.00
Traded proportion	0.864	0.889	0.000	0.000	0.000	0.000	0.000	0.000
Non-traded proportion	0.136	0.111	0.000	0.000	0.000	0.000	0.000	0.000

* Social cost assumes half the private cost due to import duties on petroleum and vehicles.
** Reflect average rate of subsidy on imported fertilizer.

- The Dar es Salaam cost insurance and freight (CIF) price is equal to the sum of free on board (FOB) price at the port of origin plus freight insurance and transport cost from the port of origin to Dar es Salaam (3 = 1 + 2).
- The Dar es Salaam CIF price has to be converted into local currency (4 = 3 x exchange rate). This is the first place where private and social prices diverge because the private and social exchange rates are different.
- Shipping the goods from the border to the local market involves additional costs, including unloading, warehouse, transport, taxes, and mark-up. Thus the price at the market level is (10 = 4 +...+ 9).
- If farmers receive a subsidy from the government, the private market price is less (12 = 10 - 11). The social price remains the same (12 = 10).
- Shipping the goods from the market to the farm-gate involves some more transportation cost. Thus the farm-gate price is (14 = 12 + 14).
- The price is converted from Shs/MT to Shs/kg (15 = 14/1000). The price per kg is also converted into the price of effective contents (16 = 15/percentage of effective contents).
- The last two rows estimate the shares of tradable and non-tradable components.

(3) Explanation for Table 4.3 (Private and Social Prices of Morogoro Rice)

- Tanzania is a net importer of rice. The appropriate prices should be the import parity prices.
- CIF prices for rice at Dar es Salaam port is the FOB prices at the port of origin plus freight insurance and cost from the port of origin to Dar es Salaam port (3 = 1 – 2).
- The CIF prices have to be converted into local currency by multiplying the US$ price with foreign exchange rates (4 = 3 x exchange rates). As the private and social exchange rates are different the private and social FOB prices measured in local currency are different.
- To transport rice from the port to the local market involves additional costs, including, warehouse, transport, taxes and mark-up costs. Thus, the parity prices at the market level are equal to the CIF prices plus

Table 4.3. Morogoro Rice. Private and Social Prices for Rice (1994/95)

Import Parity Prices: At Morogoro	Private	Social
Exchange rates (Shs/$)	540.7	550.62
1 CIF: Port of origin ($/T)	0	0
2(+) Insurance, freight & handling ($/T)	0	0
3 CIF Dar es Salaam ($/T)	243	243
4(*) CIF Dar es Salaam (Shs/T)	131,390	133,801
5(+) Import tariff (*40%) (Shs/T)	52,556	0
6(+) Handling & Transport in DSM (Shs/T)	9,230	9,230
7 Dar es Salaam market Price	193,176	143,031
8(-) Milling cost (Shs/T)	7200	7200
9(+) Value of bran (Shs/T)	1650	1650
10 Price at Mill (Shs/T)	187,626	137,481
11(*) Price at mill paddy equivalent (65%) (Shs/T)	121,957	89,362
12(-) Handling, Transport and other costs to Morogoro	27,800	27,800
13 Paddy price: farmgate (Shs/T)	94,157	61,562
14(/) Paddy price: farm-gate (Shs/kg)	94.16	61.56

Table 4.4. Morogoro. Revenues, Costs and Profits of Rice (1994/95)(Shs/ha)

		Private values accounts					Social value accounts					
Accounts	**Units**	**Private price (Shs/kg)**	**Private values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**	**Social price (Rs/kg)**	**Social values (Rs/ac)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Rs)**	**N-trade value (Rs)**
I. Revenues Accounts													
1 Main product (kg)	1186	94.2	111670					61.6	73013				
2 By-product (kg)	1186	9.4	11167					6.2	7301				
Total revenues			122837						80314				
II. Cost Accounts													
A. Material inputs													
1 Tractor (hrs)	7.0	6548.2	45837	0.52	0.48	24052.2	21785.1	6103.1	42722	0.52	0.48	22393	20328
Tillage (hrs)	7.0	3893.5	27255	0.58	0.48	15941.4	12953.3	4361.4	30530	0.58	0.42	17857	12673
2 Bullock (hrs)	0.0	0.0	0	0.00	1.00	0.0	0.0	10.0	0.0	0.00	1.00	0.0	0.0
3 Seeds (kg)	34.0	200.0	6800	0.90	0.10	6120.0	680.0	5.0	70.0	0.90	0.10	153.0	17.0
4 Fertilizers (pure contents)													
N (kg)	46.0	238.0	10949	0.86	0.14	9462.4	1487.0	227.4	10462.1	0.00	0.11	0.0	1162.5
P (kg)	0.0	0.0	0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
K (kg)	0.0	0.0	0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
5 Pesticides (kg)	0.0	0.0	0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
6 Water			980	0.00	1.00	0.0	980.0		2000.0	0.00	1.00	0.0	2000.0
7 Others			1560	0.00	1.00	0.0	1560.0		300.0	0.00	1.00	0.0	300.0
Total material			93381			55576	39445		86184			40404	36481
B Labor													
Total Labor (Hrs)	218.0	320.0	69760	0.00	1.00	0.0	69760.0	4.4	954.8	0.00	1.00	0.0	954.8
Harvest (hrs) C	0.0	0.0	0	0.00	1.00	0.0	0.0	4.4	0.0	0.00	1.00	0.0	0.0
Land			3885	0.00	1.00	0.0	3885.4		1200.0	0.00	1.00	0.0	1200.0
D Total costs			167027			55576	113091		88339			40404	38635
III. Profits Accounts (Shs/Hectare)			-44190						-8024				

loading, and transportation cost (7 = 4 + 5 + 6).

- Milling cost has to be subtracted (8), but the by-product (rice bran) has to be added (9) to the market price at Dar es Salaam (7), so that 10 = 7 – 6 + 9.
- The rice price at mill (10) has to be converted into paddy equivalent (11) assuming a conversion factor of 0.65, so that 11 = 10 X (0.65).
- Rice from Dar es Salaam market has to be "shipped" to the farm-gate, incurring handling and transportation costs. Thus, 13 = 11 – 12.
- Lastly, paddy price is converted from Shs/MT to Shs/kg, or 14 = 13/1000.

(4) Explanations for Table 4.4 (Revenues, Costs, and Profits of Morogoro Rice)

- Revenues are calculated by multiplying the yield per acre measured in kg by the private and social prices. Yield is estimated by using historical data or prediction. Prices are obtained from the last row of Table 4.2.
- Cost items are classified into materials, labor, and land. Materials include tractor/tillage, seeds, fertilizers, and others. The quantities of all these items are measured in kg or days per hectare.
- The prices of tractor/tillage and the shares of tradable and non-tradable components are derived from the last three rows of Table 4.1.
- The prices of fertilizers and the shares of tradable and non-tradable components are derived from the last three rows of Table 4.2. Remember the quantities and prices of these inputs are measured in terms of pure (effective) contents.
- The prices of other material inputs are estimated according to experiences. The shares of tradable and non-tradable components are estimated on an ad hoc basis.
- Labor and land are treated as pure domestic (non-tradable) factors. The prices of labor are estimated arbitrarily. The price of land is a very complicated issue. It deserves a separate section to discuss its calculation. In the previous section, it has been briefly addressed.
- Profits are derived by subtracting the total costs of production from the total revenues.

(5) Explanations for Table 4.5 (Morogoro Rice PAM Results)

- Revenues, costs, and profits are all derived from Table 4.3.
- NPC = 122837/80314 = 1.53
  EPC = (122837 – 55576) / (80314 – 40404) = 1.69
  DRC = 38635 / (80314 – 40404) = 0.97.
- As NPC = 1.53, it means that paddy producers receive 53 percent more than the import parity price for their product.
- EPC = 1.69 means that by taking price distortion in both the product and input markets into account,

Table 4.5. A PAM for Rice: At Morogoro, 1994/95 (Shs/ha)

Values basis	Total Revenue	Costs of production: Tradable	Costs of production: N-tradable	Profits
Private values	122837	55576	113091	-44190
Social values	80314	40404	38635	-8024
Divergence	42523	15172	74455	-36165

NPC: 1.53 EPC: 1.69 DRC: 0.97

Table 4.6. Summary of PAM Results for the Considered Enterprises

Product	Location	Measures of policy distortions and comparative advantage			
		Net transfers	NPC	EPC	DRC
1. Northern arabica coffee	Kilimanjaro	27548	1.19	1.13	1.98
2. Southern arabica coffee	Mbozi	-19115	1.03	0.91	0.91
3. Mwanza cotton - Hand Hoe	Mwanza	-19972	0.91	0.91	0.06
4. Kahama cotton - Hand hoe	Kahama	-53316	0.61	0.53	0.60
6. Kahama cotton - Ox-plough	Kahama	-44237	0.61	0.47	0.70
7. Morogoro rice	Morogoro	-36165	1.53	1.69	0.97
8. Morogoro maize	Morogoro	-25671	1.55	1.73	1.47

Source: Own calculations from survey data

farmers receive 69 percent above the value-added created by the employment of domestic factors.

- DRC = 0.97 means that the country is earning US$1 of net value at a cost of US$0.97 of expenditures on domestic factors. The country has a comparative advantage in paddy production in 1994/95.
- There is a net transfer of Shs 44,885 per hectare of profit from the farming sector to the rest of the economy.

4.1.2 Findings from the PAM for the other Enterprises Considered

The Case of Maize

Like the case of rice, five tables are constructed for maize using 1994/95 data (Appendix 1, Tables A.1-A.5). The explanations and calculations are similar as for rice.

- Revenues, costs and profits are all derived from Appendix 1, Table A.4.
- The PAM results are shown in Appendix 1, Table A.5.

  NPC = 103305 / 58096 = 1.55
  EPC = (103305-58096)/66544-40359) = 1.73
  DRC = 38372/(66544-40359) = 1.47
- As NPC = 1.55, it means that maize producers receive 55 percent above the import parity price for their product.
- As EPC = 1.73, it means that by taking price distortion in both the product and input markets into account, farmers receive 73 percent above the value-added created by the employment of domestic factors.
- As DRC = 1.47 means that the country is earning US$1 of net value at a cost of only US$1.47 of expenditures on domestic factors. The country had a comparative disadvantage in maize production in 1994/95.
- There is a net transfer of Shs 25,671 per hectare of profit from the farming sector to the rest of the economy.

The Case of Coffee

This case study is directed towards smallholder mild arabica coffee producers in the northern and southern coffee production zones. In the coffee growing areas of Tanzania there are two main smallholder production

systems: the coffee banana system and the coffee monocrop system. In the coffee banana system of Kilimanjaro and Arusha, coffee is intercropped with bananas. In this zone the major competing enterprise is dairy. In the coffee monocrop system found in the Southern zone coffee competes mainly with maize.

Table 4.7. Summary of the PAM Results for the Northern and Southern Highland Mild Arabica Coffee Zones

	NPC	EPC	DRC
Northern Zone	1.19	1.13	1.98
Southern Zone	1.03	.091	0.91

Source: PAM results of Appendix 1, Table A.9 Northern Highlands and Table A.13 Southern Highlands

Interpretation of PAM results

The PAM analysis tables are presented below (Appendix 1, Tables A.6-A.9 for the northern zone and Tables A.10-A.13 for the southern zone). A summary of the results for the two coffee production zones is shown in Table 4.7.

In both zones farmers received producer prices above comparable parity prices as indicated by the NPC results. If both the output and input markets are considered, farmers in the northern zone are positively protected while those in the Southern zone are negatively protected. DRC results show that the country has a comparative disadvantage in the production of Northern zone coffee. For every US dollar earned the country spends $1.98. On the contrary the country possesses a comparative advantage in the production of coffee in the Southern Zone.

The Case of Cotton

Cotton is grown in two major producing areas, i.e., the WCGA and the ECGA. Most of the cotton however is produced in the WCGA. Within this zone only two regions, Mwanza and Shinyanga constitute the main producers contributing about 75% of the total cotton output in the country. It was also pointed out that smallholder farmers produce almost all the cotton in the country. The cotton production system under smallholder agriculture depends largely on a simple cultivation tool, the hand hoe. In Mwanza and Shinyanga regions, some farmers use oxen or hired tractor for cultivation. Most other operations are done by family and/or hired labor.

Lint is the major export from cotton. Oil and cake are mainly consumed domestically. The appropriate price of these two by-products is the FOB border price at the DSM port. On the other hand FOB prices for lint is the CIF price at the port of destination minus Insurance and Freight from DSM to that port.

The results shown are derived from Mwanza cotton farmers using hand hoe, Kahama farmers using hand hoe, and those using ox-plough technology. The results of the PAM coefficients are shown in Appendix 1, Tables A.4-A.8.

Interpretation of Cotton PAM Results

The measures of distortion and comparative advantage generated by the PAM for Mwanza cotton indicate that producers received prices which are below the parity price for their product. The NPC is less than one with a value of 0.91. The value of the EPC is 0.91 that indicates that producers are negatively protected in the input market. The value of the DRC on the other hand indicates that Tanzania has a comparative advantage in cotton production. Similar results are shown for Kahama cotton as indicated in Table 4.6.

5. Conclusions and Policy Recommendations

The Policy Analysis Matrix (PAM) methodology was used to determine Tanzania's comparative advantage in the production of major cash and food crops (coffee, cotton, maize and rice) in different farming systems and agro-ecological zones. The methodology was also used to assess the effect of government intervention policies on the production of these crops.

The DRC results derived from the PAM indicate a comparative economic advantage of producing cotton in WCGA, coffee in the southern zone and rice in Morogoro. The production of maize in Morogoro and arabica coffee in the northern zone indicate a comparative economic disadvantage, implying inefficient use of resources to produce the commodities in these areas. Low yields are probably among the important factors creating this comparative disadvantage in the production of maize in Morogoro and arabica coffee in the northern zone.

The measures of distortion (NPC and EPC) suggest that food crops were protected by government pricing policies. Cash crops (with the exception of coffee in the northern zone) were taxed. Government protection policy on food crops may be desirable due to some social and political objectives such as food security or poverty alleviation, which cannot be easily qualified.

In summary, the recommendations emanating from this study are:

- If farmers are to increase resource allocations to a particular crop, more effective measures are needed to improve production constraints and, consequently, farm gross margins. For example, policy measures are needed to revive the production of Northern Highlands coffee.
- Given the potential for high quality output, measures need to be taken to improve quality, which has a high demand on the world market.
- Policy measures are necessary to improve processing quality capacity.
- Research the role of competing products, e.g., products that compete with cotton and their effect on the domestic textile milling industry.

6. Notes

[1] Various factors have an influence on the comparative advantage which regions or countries have over each other. These factors must therefore be accounted for, when conducting comparative economic advantage analysis, and in this case DRC analysis. Some of the factors that should be considered in planned research can be categorised as shown in Appendix 1.

[2] The recommended basal application rates for TSP and NPK range from 100-400 kg/ha, whereas top dressing fertilisers are in the range of 200-400-600 for CAN; 250-500-75 for SA; and 100-200-350 for UREA.

[3] These regions account for about 70 - 80% of the total paddy produced.

[4] The five PAM tables for rice are located at the end of this section.

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Appendix 1. PAM Tables

Table A.1. Morogoro Maize. Private and Social Prices for Tractors/Tillage (1994/95)

	Tractor		Tillage	
A. Fixed Cost	**Private**	**Social**	**Private**	**Social**
1 CIF Dar-es-Salaam [$]	32,349	32,349	6,470	6,470
2 Exchange Rates [Shs/US$]	540.70	550.62	540.70	550.62
3 CIF Cost [Shs]	17,491,104	17,812,006	3,498,221	3,562,401
4 Port Charges [*5%]	874,555	890,600	174,911	178,120
5 Purchase Price [Shs]	18,365,660	18,702,607	3,673,132	3,740,521
6 Surcharge @ 10%	1,836,566	0	0	0
7 Markup @ 10%	1,836,566	1,870,261	0	374,052
8 Total Price [Shs]	22,038,791	20,572,867	3,673,132	4,114,573
9 Salvage value (10%)	2,203,879	2,057,287	367,313	411,457
10 Initial capital cost	19,834,912	18,515,581	3,305,819	3,703,116
11 Use life (years)	10	10	15	15
12 Rate Of Interest	0.31	0.31	0.31	0.31
13 Hours Per Year	1,000	1,000	250	250
14 Depreciation [Shs/hr]	1983.49	1851.56	881.55	987.50
15 Capital Cost [Shs/hr]	3,416.01	3,188.79	2,277.34	2,551.04
16 Total cost [Shs/hr]	5399.50	5040.35	3158.89	3538.53
B. Variable Costs				
1 Repair Cost Coefficient	0.05	0.05	0.05	0.05
2 Repair Cost [Shs/year]	1,101,940	1,028,643	183,657	205,729
3 Repair cost [Shs/hr]	1,101.94	1,028.64	734.63	822.91
6 Fuel Cost (Shs/hr)	14.30	6.57	0	0
9 Lubricants (oil) (Shs/hr)	5.72	3.79	0	0
10 Labor (Shs/hr)	23.83	23.83	0	0
11 Insurance/tax (Shs/hr)	2.9	0	0	0
13 Total (Shs/hr)	1148.69	1062.83	734.63	822.91
C. Grand total cost (Shs/hr)	6548.19	6103.19	3893.52	4361.45
D. Traded proportion	0.52	0.52	0.58	0.58
E. Non-traded proportion	0.48	0.48	0.42	0.42

Notes: (1) It is assumed that traded elements include total fixed cost, fuel, and mobile oil costs. (2) Non-traded proportion includes repair, labor, insurance, and tax costs.

Table A.2. Private and Social Prices of Fertilizers (1994/95)

	UREA		DAP		NP		Pesticides	
	Private	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**
Exchange Rate (Shs/$)	540.7	550.62	540.7	550.62	540.7	550.62	540.7	550.62
1 FOB: Port Of Origin $/T	0	0	0	0	0	0	0	0
2 Insurance & Freight $/T	0	0	0	0	0	0	0	0
3 CIF Dar-es-Salaam [$/T]	163	163	0	0	0	0	0	0
4 CIF Dar-es-Salaam [Shs/T]	88,134	89,751	0	0	0	0	0	0
5 Unloading	1,300	1,300	0	0	0	0	0	0
6 Port Handling	3,460	3,460	0	0	0	0	0	0
7 Warehouse Cost	1,920	1,920	0	0	0	0	0	0
8 Transportation*	3,780	1,890	0	0	0	0	0	0
9 Marketing Margins	1,700	1,700	0	0	0	0	0	0
10 Domestic Value	100,294	100,021	0	0	0	0	0	0
11 Less Subsidy**	0	0	0	0	0	0	0	0
12 Domestic Price	100,294	100,021	0	0	0	0	0	0
13 Transport to Farmgate	9,200	4,600	0	0	0	0	0	0
14 Price at Farmgate (Shs/T)	109,494	104,621	0	0	0	0	0	0
15 Price per KG	109.49	104.62	0.00	0.00	0.00	0.00	0.00	0.00
16 Price/Kg (pure contents)	238.03	227.44	0.00	0.00	0.00	0.00	0.00	0.00
Traded proportion	0.864	0.889	0.000	0.000	0.000	0.000	0.000	0.000
Non-traded proportion	0.136	0.111	0.000	0.000	0.000	0.000	0.000	0.000

* Social cost assumes half the private cost due to import duties on petroleum and vehicles.
** Reflect average rate of subsidy on imported fertilizer.

Table A.3. Private and Social Prices for Maize (1994/95)

Import Parity Prices: at Morogoro	Private	Social
Exchange rates (Shs/$)	540.7	550.62
1 CIF: Port of origin ($/T)	0	0
2(+) Insurance, freight & handling ($/T)	0	0
3 CIF Dar-es-Salaam ($/T)	154	154
4(*) CIF Dar-es-Salaam (Shs/T)	83,268	84,795
5(+) Import tariff (*40%) (Shs/T)	33,307	0
6(+) Handling & Transport to NMC (Shs/T)	9,230	9,230
7 Dar-es-Salaam Market Price	125,805	94,025
8(-) Milling cost (Shs/T)	7200	7200
9(+) Value of bran (Rs/T)	1700	1700
10 Price at Mill (Shs/T)	120,305	88,525
11(*) Price at mill grain equivalent (83%) (Shs/T)	99,853	73,476
12(-) Handling, Transport and other costs to Morogo	25,730	25,730
13 Maize price: farmgate (Shs/T)	74,123	47,746
14(/) Maize price: farm-gate (Shs/kg)	74.12	47.75

Table A.5. A PAM for Maize: At Morogoro, 1994/95 (Shs/ha)

		Costs of production		
Values basis	**Total Revenue**	**Tradable**	**N-tradable**	**Profits**
Private values	103,305	58,096	94,007	-47,158
Social values	66,544	40,359	38,372	-21,487
Divergence	36,762	17,737	55,635	-25,671

NPC: 1.55 EPC: 1.73 DRC: 0.47

Table A.4. Morogoro. Revenues, Costs, and Profits of Maize (1994/95)(Shs/ha)

		Private values accounts						Social value accounts					
Accounts	**Units**	**Private price (Shs/kg)**	**Private values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**	**Social price (Rs/kg)**	**Social values (Rs/ac)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Rs)**	**N-trade value (Rs)**
I. Revenues Accounts													
1 Main product (kg)	1267	74.1	93914					47.7	60494				
2 By-product (kg)	1267	7.4	9391					4.8	6049				
Total revenues			103305						66544				
II. Cost Accounts													
A. Material inputs													
1 Tractor (hrs)	7.0	6548.2	45837	0.52	0.48	24052	21785	6103.2	42722	0.52	0.48	22394	20328
Tillage (hrs)	7.0	3893.5	27255	0.58	0.48	15941	12953	4361.4	30530	0.58	0.42	17857	12673
2 Bullock (hrs)	0.0	0.0	0	0.00	1.00	0.0	0.0	10.0	0	0.00	1.00	0	0
3 Seeds (kg)	24.0	400.0	9600	0.90	0.10	8640	960.0	5.0	120	0.90	0.10	108	12
4 Fertilizers (pure contents)													
N (kg)	46.0	238.0	10949	0.86	0.14	9462	1487	227.4	10462	0.00	0.11	0	1162
P (kg)	0.0	0.0	0	0.00	0.00	0	0	0.0	0	0.00	0.00	0	0
K (kg)	0.0	0.0	0	0.00	0.00	0	0	0.0	0	0.00	0.00	0	0
5 Pesticides (kg)	0.0	0.0	0	0.00	0.00	0	0	0.0		0.00	0.00	0	0
6 Water			723	0.00	1.00	0	723		2000	0.00	1.00	0	2000
7 Others			1299	0.00	1.00	0	1299		300	0.00	1.00	0	300
Total material			95663			58096	39207		86135			40359	36476
B Labor													
Total Labor (Hrs)	159.0	320.0	50880	0.00	1.00	0	50880	4.4	696	0.00	1.00	0	696
Harvest (hrs)	0.0	0.0	0	0.00	1.00	0	0	4.4	0	0.00	1.00	0	0
C Land			3920	0.00	1.00	0	3920		1200	0.00	1.00	0	1200
D Total costs			150463			58096	94007		88031			40359	38372
III. Profits Accounts (Shs/Hectare)			-47158						-21487				

Table A.6. Northern Highlands Coffee. Private and Social Prices for Fertilizers and Pesticides, (1995-96)

	Can		Bravo		Red Copper		Selecron		Thiodan	
	Private	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**
Exchange Rate (Shs/$)	595	600	595	600	595	600	595	600	595	600
1 FOB: Port Of Origin $/T	0	0	0	0	0	0	0	0	0	0
2(+) Insurance & Freight $/T	0	0	0	0	0	0	0	0	0	0
3 CIF DSM $/T	296	296	12,269	12,269	3,697	3,697	13,445	13,445	3,361	3,361
4(*) CIF DSM TSH/T	176,120	177,600	7,300,055	7,361,400	2,200,000	2,218,487	7,999,775	8,067,000	1,999,795	2,016,600
5(+) Unloading	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
6(+) Port Handling	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130
7(+) Warehouse Cost	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100
8(+) Transportation*	4,300	2,150	4,300	2,150	4,300	2,150	4,300	2,150	4,300	2,150
9(+) Marketing Margins	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795
10(SM) Domestic Value	195,845	195,175	7,319,780	7,378,975	2,219,725	2,236,062	8,019,500	8,084,575	2,019,520	2,034,175
11(-) Less Subsidy**	0	0	0	0	0	0	0	0	0	0
12 Domestic Price	195,845	195,175	7,319,780	7,378,975	2,219,725	2,236,062	8,019,500	8,084,575	2,019,520	2,034,175
13(+) Transport to Farmgate	7,000	3,500	7,000	3,500	7,000	3,500	7,000	3,500	7,000	3,500
14 Price at Farmgate TSH/T	202,845	198,675	7,326,780	7,382,475	2,226,725	2,239,562	8,026,500	8,088,075	2,026,520	2,037,675
15(/) Price per KG	202.85	198.68	7326.78	7382.48	2226.73	2239.56	8026.50	8088.08	2026.52	2037.68
16(/) Price/Kg (pure contents)	440.97	431.90	7326.78	7382.48	2226.73	2239.56	8026.50	8088.08	2026.52	2037.68
Traded proportion	0.896	0.908	0.997	0.998	0.991	0.992	0.997	0.998	0.990	0.991
Non-traded proportion	0.104	0.092	0.003	0.002	0.009	0.008	0.003	0.002	0.010	0.009

* Social cost assumes half the private cost due to import duties on petroleum and vehicles.
** Reflect average rate of subsidy on imported fertilizer.

Table A.7. Northern Highlands Coffee. Private and Social Prices for Coffee (1995-96)

	Coffee	
	Private	**Social**
Exchange rates (Shs/$)	595	600
1 CIF: DSM $/T	0	0
2(-) Insurance & Freight $/T	0	0
3 FOB DSM $/T	1,460	1,460
4(*) FOB DSM Shs/t	868,700	876,000
5(-) Loading Shs/T	1,190	1,190
6(-) Transport Shs/T	23,250	23,250
7 Price at auction, Shs/T	844,260	851,560
8(-) Processing cost Shs/T	0	0
9 Hulling parity Shs/T	844,260	851,560

	Coffee Parchment	
	Private	**Social**
11(*) Parity price of coffee at curing plant (Shs/T)	844260	851560
12(-) Hulling cost (Shs/T)	14820	19500
13(-) Marketing cost from farm to curing plant (Shs/T)	146720	62435
14 Parity price of coffee at farmgate (Shs/T)	682720	769625
15(/) Price per kg (Shs)	682.72	769.625

Table A.9. A PAM for Coffee: Northern Highlands (Shs/ha)

		Costs of production		
Values basis	**Total Revenue**	**Tradable**	**N-tradable**	**Profits**
Private values	364590	158201	357777	-151388
Social values	307224	124074	362086	-178936
Divergence	57366	34127	-4309	-27548

NPC: 1.19 EPC: 1.13 DRC: 1.98

Table A.8. Northern Highlands Coffee. Revenues, Costs, and Profit per Hectare (Shs/ha)

		Private values accounts						Social value accounts					
Accounts	**Units**	**Private price (Shs/kg)**	**Private values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**	**Social price (Shs/ kg)**	**Social values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**
I. Revenues Accounts													
1 Main product (kg)	450.0	800.0	360000.0					680.5	306243.0				
2 By-product (kg)	0.0		0.0						0.0				
Total revenues			360000.0						306243.0				
II. Cost Accounts													
A. Material inputs													
1 Tractor (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
Tillage (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
2 Bullock (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
3 Seeds (kg)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
4 Fertilizers (pure contents)													
CAN (kg)	50.0	441.0	44096.7	0.90	0.10	39515.2	4581.5	431.9	21595.1	0.91	0.09	19611.4	1983.7
5 Pesticides (kg)													
Bravo (litre)	1.0	7326.8	36633.9	1.00	0.0094	36528.5	105.4	7382.5	36912.4	1.00	0.00	36821.1	91.2
Red copper (kg)	25	2226.72	55668.1	0.9905	0.00	55141.3	526.9	2239.56	55989.1	0.9918	0.0081	55532.8	456.3
6 Selecron (litre)	1.0	8026.5	8026.5	1.00	0.01	8005.4	21.1	8088.1	8088.1	1.00	0.00	8069.8	18.2
7 Thiodan (litre)	1.0	2026.5	4053.0	1.00	0.00	4010.9	42.2	2037.7	4075.4	0.99	0.01	4038.9	36.5
8 Tools			15000			15000.0	0.0	15000					
Total material			163487.3			158201.3	5277.0		126660.0			124074.0	2585.9
B Labor													
General (hrs)	880.0	187.5	165000.0	0.00	1.00	0.0	165000.0	187.5	165000.0	0.00	1.00	0.0	165000.0
Harvest (hrs)	904.0	187.5	169500.0	0.00	1.00	0.0	169500.0	187.5	169500.0	0.00	1.00	0.0	169500.0
C Land			18000.0	0.00	1.00	0.0	18000.0		25000.0	0.00	1.00	0.0	25000.0
D Total costs			515978.3			158201.3	357777.0		486160.0			124074.0	362085.9
III. Profits Accounts (Shs/Hectare)			-155978.3						-179917.0				

Table A.10. Southern Highlands Coffee. Private and Social Prices for Fertilizers and Pesticides, (1995-96)

	Can		Bravo		Red Copper		Selecron		Thiodan	
	Private	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**
Exchange Rate (Shs/$)	595	600	595	600	595	600	595	600	595	600
1 FOB: Port Of Origin $/T	0	0	0	0	0	0	0	0	0	0
2(+) Insurance & Freight $/T	0	0	0	0	0	0	0	0	0	0
3 CIF DSM $/T	296	296	12,269	12,269	3,697	3,697	13,445	13,445	3,361	3,361
4(*) CIF DSM TSH/T	176,120	177,600	7,300,055	7,361,400	2,200,000	2,218,487	7,999,775	8,067,000	1,999,795	2,016,600
5(+) Unloading	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
6(+) Port Handling	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130	3,130
7(+) Warehouse Cost	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100
8(+) Transportation*	4,300	2,150	4,300	2,150	4,300	2,150	4,300	2,150	4,300	2,150
9(+) Marketing Margins	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795	8,795
10(SM) Domestic Value	195,845	195,175	7,319,780	7,378,975	2,219,725	2,236,062	8,019,500	8,084,575	2,019,520	2,034,175
11(-) Less Subsidy**	0	0	0	0	0	0	0	0	0	0
12 Domestic Price	195,845	195,175	7,319,780	7,378,975	2,219,725	2,236,062	8,019,500	8,084,575	2,019,520	2,034,175
13(+) Transport to Farmgate	7,000	3,500	7,000	3,500	7,000	3,500	7,000	3,500	7,000	3,500
14 Price at Farmgate TSH/T	202,845	198,675	7,326,780	7,382,475	2,226,725	2,239,562	8,026,500	8,088,075	2,026,520	2,037,675
15(/) Price per KG	202.85	198.68	7326.78	7382.48	2226.73	2239.56	8026.50	8088.08	2026.52	2037.68
16(/) Price/Kg (pure contents)	440.97	431.90	7326.78	7382.48	2226.73	2239.56	8026.50	8088.08	2026.52	2037.68
Traded proportion	0.896	0.908	0.997	0.998	0.991	0.992	0.997	0.998	0.990	0.991
Non-traded proportion	0.104	0.092	0.003	0.002	0.009	0.008	0.003	0.002	0.010	0.009

* Social cost assumes half the private cost due to import duties on petroleum and vehicles.
** Reflect average rate of subsidy on imported fertilizer.

Table A.11. Southern Highlands Coffee. Private and Social Prices for Coffee (1995-96)

	Coffee	
	Private	**Social**
Exchange rates (Shs/$)	595	600
1 CIF: DSM $/T	0	0
2(-) Insurance & Freight $/T	0	0
3 FOB DSM $/T	1,460	1,460
4(*) FOB DSM Shs/t	868,700	876,000
5(-) Loading Shs/T	1,190	1,190
6(-) Transport Shs/T	25,250	25,250
7 Price at auction, Shs/T	842,260	849,560
8(-) Processing cost Shs/T	0	0
9 Hulling parity Shs/T	842,260	849,560

	Coffee Parchment	
	Private	**Social**
11(*) Parity price of coffee at curing plant (Shs/T)	844260	849560
12(-) Hulling cost (Shs/T)	15000	225000
13(-) Marketing cost from farm to curing plant (Shs/T)	146720	62435
14 Parity price of coffee at farmgate (Shs/T)	680540	562125
15(/) Price per kg (Shs)	680.54	562.125

Table A.13. A PAM for Southern Highlands Mild Arabica Coffee (Shs/ha)

		Costs of production		
Values basis	**Total Revenue**	**Tradable**	**N-tradable**	**Profits**
Private values	385000	158201	222777	4022
Social values	374297	124074	227086	23137
Divergence	10703	34127	-4309	-19115

NPC: 1.03 EPC: 0.91 DRC: 0.91

Table A.12. Southern Highlands Coffee. Revenues, Costs, and Profit per Hectare (Shs/ha)

		Private values accounts					Social value accounts					
Accounts	**Units**	**Private price (Shs/kg)**	**Private values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**	**Social price (Shs/ kg)**	**Social values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**
I. Revenues Accounts													
1 Main product (kg)	550.0	700.0	385000.0					680.5	374297.0				
2 By-product (kg)	0.0		0.0						0.0				
Total revenues			385000.0						374297.0				
II. Cost Accounts													
A. Material inputs													
1 Tractor (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
Tillage (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
2 Bullock (hrs)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
3 Seeds (kg)	0.0	0.0	0.0	0.00	0.00	0.0	0.0	0.0	0.0	0.00	0.00	0.0	0.0
4 Fertilizers (pure contents)													
CAN (kg)	50.0	441.0	44096.7	0.90	0.10	39515.2	4581.5	431.9	21595.1	0.91	0.09	19611.4	1983.7
5 Pesticides (kg)													
Bravo (litre)	1.0	7326.8	36633.9	1.00	0.00	36528.5	105.4	7382.5	36912.4	1.00	0.00	36821.1	91.2
Red copper (kg)	25	2226.72	55668.1	0.9905	0.0094	55141.3	526.9	2239.56	55989.1	0.9918	0.0081	55532.8	456.3
6 Selecron (litre)	1.0	8026.5	8026.5	1.00	0.00	8005.4	21.1	8088.1	8088.1	1.00	0.00	8069.8	18.2
7 Thiodan (litre)	1.0	2026.5	4053.0	0.99	0.01	4010.9	42.2	2037.7	4075.4	0.99	0.01	4038.9	36.5
8 Tools			15000	1	0	15000.0	0.0	15000					
Total material			163487.3			158201.3	5277.0		126660.0			124074.0	2585.9
B Labor													
General (hrs)	1176.0	87.5	102900.0	0.00	1.00	0.0	102900.0	87.5	102900.0	0.00	1.00	0.0	102900.0
Harvest (hrs)	1104.0	87.5	96600.0	0.00	1.00	0.0	96600.0	87.5	96600.0	0.00	1.00	0.0	96600.0
C Land			18000.0	0.00	1.00	0.0	18000.0		25000.0	0.00	1.00	0.0	25000.0
D Total costs			380978.3			158201.3	222777.0		351160.0			124074.0	227085.9
III. Profits Accounts (Shs/Hectare)			4021						23137.0				

Table A.14. Mwanza Cotton. Private and Social Prices for Tractors/Tillage (1993/94)

	Tractor		Tillage	
A. Fixed Cost	**Private**	**Social**	**Private**	**Social**
1 CIF Dar-es-Salaam [$]	33,750	33,750	6,750	6,750
2 Exchange Rates [Shs/US$]	407.44	448.21	407.44	448.21
3 CIF Cost [Shs]	13,751,100	15,127,088	2,750,220	3,025,418
4 Port Charges [*5%]	687,555	756,354	137,511	151,271
5 Purchase Price [Shs]	14,438,655	15,883,442	2,887,731	3,176,688
6 Surcharge @ 10%	1,443,866	0	0	0
7 Markup @ 10%	1,443,866	1,588,442	0	0
8 Total Price [Shs]	17,326,386	17,471,786	2,887,731	3,176,688
9 Salvage value (10%)	1,732,639	1,747,179	288,773	317,669
10 Initial capital cost	15,593,747	15,724,607	2,598,958	2,859,020
11 Use life (years)	10	10	15	15
12 Rate Of Interest	0.30	0.30	0.30	0.30
13 Hours Per Year	1,000	1,000	250	250
14 Depreciation [Shs/hr]	1559.37	1572.46	693.06	762.41
15 Capital Cost [Shs/hr]	2,598.96	2,620.77	1,732.64	1,906.01
16 Total cost [Shs/hr]	4158.33	4193.23	2425.69	2668.42
B. Variable Costs				
1 Repair Cost Coefficient	0.05	0.05	0.05	0.05
2 Repair Cost [Shs/year]	866,319	873,589	144,387	158,834
3 Repair cost [Shs/hr]	866.32	873.59	577.55	635.34
6 Fuel Cost (Shs/hr)	10.20	6.54	0	0
9 Lubricants (oil) (Shs/hr)	4.32	2.91	0	0
10 Labor (Shs/hr)	12.83	12.83	0	0
11 Insurance/tax (Shs/hr)	0	0	0	0
13 Total (Shs/hr)	893.67	895.87	577.55	635.34
C. Grand total cost (Shs/hr)	5052.00	5089.10	3003.24	3303.76
D. Traded proportion	0.52	0.52	0.58	0.58
E. Non-traded proportion	0.48	0.48	0.42	0.42

Notes: (1) It is assumed that traded elements include total fixed cost, fuel, and mobile oil costs. (2) Non-traded proportion includes repair, labor, insurance, and tax costs.

Table A.15. Mwanza Cotton. Private and Social Prices of Fertilizers (1993/94)

	SA		TSP		Batteries		Pesticides	
	Private	**Social**	**Private**	**Social**	**Private**	**Social**	**Private**	**Social**
Exchange Rate (Shs/$)	407	448	407	448	407	448	407	448
1 FOB: Port Of Origin $/T	25 0	250	260	260	185	185	4570	4570
2 Insurance & Freight $/T	86	86	86	86	52	52	86	86
3 CIF Dar-es-Salaam [$/T]	336	336	346	346	237	237	4656	4656
4 CIF Dar-es-Salaam [Shs/T]	136900	150599	140974	155081	96563	106226	1897041	2086866
5 Unloading	125	125	125	125	125	125	100	100
6 Port Handling	205	205	205	205	205	205	164	164
7 Warehouse Cost	58	58	58	58	58	58	58	58
8 Transportation*	250	250	250	125	250	125	200	125
9 Marketing Margins	100	100	100	100	100	100	100	100
10 Domestic Value	137638	151212	141712	155694	97301	106839	1897663	2087413
11 Less Subsidy**	0	0	0	0	0	0	0	0
12 Domestic Price	137638	151212	141712	155694	97301	106839	1897663	2087413
13 Transport to Farmgate	120	60	120	60	120	60	200	160
14 Price at Farmgate (Shs/T)	137758	151272	141832	155754	97421	1068990	1897863	2087573
15 Price per KG	138	151	142	156	97	107	1898	2088
16 Price/Kg (pure contents)	299	329	222	243	212	232	1898	2088
Traded proportion	0.995	0.996	0.995	0.996	0.993	0.995	1.000	1.000
Non-traded proportion	0.005	0.004	0.005	0.004	0.007	0.005	0.000	0.000

* Social cost assumes half the private cost due to import duties on petroleum and vehicles.
** Reflect average rate of subsidy on imported fertilizer.

Table A.16. Mwanza Cotton. Private and Social Prices for Seed Cotton (1993-94)

	Lint		Cottonseed Oil		Oil Cake	
	Private	**Social**	**Private**	**Social**	**Private**	**Social**
Exchange rates (Shs/$)	407.44	448.21	407.44	48.21	407.44	448.21
1 CIF: DSM $/T	1,660	1,660	372	372	126	126
2(-) Insurance & Freight $/T	200	200	200	200	17	17
3 FOB DSM $/T	1,460	1,460	202	202	109	109
4(*) FOB DSM Shs/T	594,862	654,387	82,303	90,538	44,411	48,855
5(-) Loading Shs/T	120	120	120	120	0	0
6(-) Transport Shs/T	3,702	3,702	3,702	3,702	0	0
7 Price after ginning Shs/T	591,040	650,565	78,481	86,716	0	0
8(-) Extracting cost Shs/T	0	0	1,729	1,729	0	0
9 Ginnery parity Shs/T	591,040	650,565	76,751	84,987	44,411	48,855
10 Conversion proportions	0.33	0.33	0.07	0.07	0.55	0.55

	Seed Cotton	
	Private	**Social**
11(*) Parity price of seed cotton at ginnery (Shs/T)	224,842	247,506
12(-) Ginning cost (Shs/T)	49.7	706
13(-) Marketing cost from farm to ginnery (Shs/T)	123	78
14 Parity price of seed cotton at farmgate (Shs/T)	224,670	246,722
15(/) Price per kg (Shs/T)	224.67	246.72

Notes: It is assumed that each kg of seed cotton can derive 0.33 kg of lint, 0.07 kg of oil and 0.55 kg of cake.

Table A.17. Mwanza Cotton. Revenues, Costs, and Profit per Hectare(Shs/ha)

		Private values accounts						Social value accounts					
Accounts	**Units**	**Private price (Shs/kg)**	**Private values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**	**Social price (Shs/ kg)**	**Social values (Shs/ha)**	**Trad-able (share)**	**N-trade (share)**	**Trade value (Shs)**	**N-trade value (Shs)**
I. Revenues Accounts													
1 Main product (kg)	1100.0	224.7	247136					246.7	271394				
2 By-product (kg)	0.0		0						0.0				
Total revenues			247136						271394				
II. Cost Accounts													
A. Material inputs													
1 Tractor (hrs)	3.0	5052.0	15156	0.52	0.48	7840	7316	5089.1	15267	0.52	0.48	7891	7377
Tillage (hrs)	3.0	3003.2	9010	0.58	0.48	5198	4349	3303.8	9911	0.58	0.42	5718	4193
2 Bullock (hrs)	36.0	10.0	360	0.00	1.00	0.0	360	10.0	360	0.00	1.00	0.0	360
3 Seeds (kg)	0.0	12.7	0	0.90	0.10	0.0	0.0	15.4	0.0	0.90	0.10	0.0	0.0
4 Fertilizers (pure contents)													
SA (kg)	50.0	299.5	14974	1.00	0.00	14901	73	328.9	16443	1.00	0.00	16381	63
TSP (kg)	50.0	221.6	11081	1.00	0.00	11028	53	243.4	12168	1.00	0.00	12123	45
K (kg)	0.0	0.0	0	0.00	0.00	0	0	0.0	0	0.00	0.00	0	0
5 Pesticides (kg)	3.4	1897.9	6453	1.00	0.00	6451	2	2087.6	7098	1.00	0.00	7096	2
6 Water			36	0.00	1.00	0	36		36	0.00	1.00	0	36
Others			293	0.00	1.00	0	293		293	0.00	1.00	0	293
Total material			57362			45418	12481		61576			49209	12369
B Labor													
General (hrs)	0.0	4.4	0	0.00	1.00	0.0	0.0	4.4	0	0.00	1.00	0.0	0
Harvest (hrs)	132.0	4.4	578	0.00	1.00	0.0	578	4.4	578	0.00	1.00	0.0	578
C Land			715	0.00	1.00	0.0	715		786	0.00	1.00	0.0	786
D Total costs			58655			45418	13774		62940			49209	13733
III. Profits Accounts (Shs/Hectare)			188482						208454				

Table A.18. Mwanza. A PAM for Cotton (Shs/ha)

Values basis	Total Revenue	Costs of production: Tradable	Costs of production: N-tradable	Profits
Private values	247136	45418	13774	188482
Social values	271394	49209	13733	208454
Divergence	-24257	-3791	41	-19972

NPC: 0.91 EPC: 0.91 DRC: 0.06

Appendix 2.
Factors Influencing the Determination of Domestic Resource Cost

a. **Biological and climatical conditions**

These included the physical climate (rainfall, temperature, number and length of sunny days, etc.); physical and chemical soil characteristics; topography; etc. In Tanzania these characteristics limit the cultivation of high value crops to specific locations. It is furthermore a source of risk to which farmers must adapt from year to year. This causes large variations in total production between regions. It can be concluded that the production patterns can largely be attributed to differences in biological and climatical conditions between regions.

b. **Level of technology and production systems**

The influence of different levels of technology on production patterns and farming activities have been documented widely. The levels of technology range from primitive (animal draught power, harvesting by hand, etc.) to highly modern methods (tractors, combines, etc.,). This has given rise to different levels of economies of scale, utilization of resources and cropping systems. Land tenure systems has also contributed to differences in cropping systems and land use patterns. These differences will result in different yields across different farming activities and cropping patterns, and will also be associated with different farm cost structures.

c. **Markets and infrastructure**

The location of markets (consumption centres) relative to production centres does have a definite influence on the comparative advantage which one region or country may have over another. The overcapitalization in infrastructure in the wrong location can be detrimental to the region's locational advantage. In this respect transportation costs between regions are of importance. Institutional arrangements in th'Dmarket place may also influence production decisions and hence lead to the unproductive use of natural resources.

d. **Resource endowments**

The competition for non-traded productive resources such as land, water, labor, etc. are on the increase. The availability of these resources for use among different cropping systems will determine their relative costs or value. The characteristics of individual farming enterprises will determine the demand for these resources, and hence the way in which they are utilised. The opportunity cost associated with the different resources should allow for their most productive utilization.

Appendix 3.
Summary of Agro-ecological Zones of Mainland Tanzania

Zone	Sub-zone	Soils & Topography	Altitude (m.a.s.l.)	Rainfall (mm/annum)	Length of growing season (months)	Representative Areas
I. Coast	a. Northern coast	Infertile sands on gently sloping to rolling uplands	< 300	-750 - 1000 rising to>1200 in the North (bimodal)	Oct - Dec March/April - June	Tanga region except Lushoto, Coast and Dar-es-Salaam
	b. Southern coast	-Alluvial soils of Rufiji -Sandy and infertile -More fertile clays on uplands and river flood plains	< 300	-800-1200 (unimodal)	Dec - April	Eastern Lindi & Mtwara regions except the Makonde plateau
II. Arid Lands	a. Northern arid lands	-volcanic ash and sediments -Soils widely variable in texture and very susceptible to soil erosion	1300 - 1800	500 - 600 (unimodal and unreliable)	March - May	Serengeti and Ngorongoro National parks, part of Masailand.
	b. Masai steppe	-Rolling plains of reddish sandy clays of low fertility susceptible to water erosion -Pangani flood plain has saline/alkaline soils	500 - 1500	400 - 600 (unimodal and unreliable)	March - May	Tarangire national park, Mkomazi game reserve, Pangani and Eastern Dodoma
III. Semi-Arid Lands	a. Central semi-arid lands	-Gently undulating plains with rocky hills and low scarps - well drained and with low fertility - alluvial hard pan and saline soils of Eastern & lake Eyasi rift valley -black cracking soils of Shinyanga	1000-1500	500-800 (unimodal & unreliable	Dec - March	Dodoma, Singida, Northern Iringa and part of Arusha, Shinyanga
	b. South Eastern semi-arid lands	-Flat or gently undulating plains with some rocky hills - in the south around Morogoro - Moderately fertile loams and clays. Infertile sands in the centre	200-600	600-800 (unimodal)	Dec - March	Morogoro region except Kilombero & Wami basins & Uluguru mountains Lindi S.W. Mtwara

Zone	Sub-zone	Soils & Topography	Altitude (m.a.s.l.)	Rainfall (mm/annum)	Length of growing season (months)	Representative Areas
IV. Plateaux	Sub-zone a. Western Plateau	-wide plains & scarps of rift valley (western). Predominantly sandy -flooded swamps of Malagarasi & Ugalla rivers have clay soil with high fertility	800-1500	800-1000 (unimodal)	Nov - April	Tabora, Rukwa (North & Central), Northern Mbeya, Kigoma, and part of Mara
	b. Southern Plateau	-Upland plains with rock hills - Clay soils of low to moderate fertility in the South, infertile sands in the North	800-1500	900-1300 (unimodal very reliable)	Nov - April	Ruvuma and Southern Morogoro
V. & VI. The Highlands	5a. Southern Highlands	-undulating plains to dissected hills & mountains -Moderately fertile clays, some with volcanic origin around Mbeya	1200-1500	800-1400 (unimodal reliable but local rain shadow areas appear)	Dec - April	Extends from Morogoro in a broad ridge to Northern shore of L.Nyasa covering part of Iringa, Mbeya
	5b. South Western Highlands	-undulating plateaux separated by scarps from adjacent Rift Valley -Soils are mainly sandy with low fertility	1400-2300	800-1000 (unimodal and reliable)	Nov - April	Ufipa plateaux in Sumbawanga district
	5c. Western Highlands	-series of North South ridges separated by swampy valleys -Loams and clay soils of low fertility on the hills -Alluvium and ponded clays in the valleys	1000-1800	1000-2000+ (bimodal)	Oct - Dec Feb - March	-Shore of lake Tanganyika in Kigoma region and Kagera region
	6a Northern highlands Sub-zone	-Volcanic uplands -soils derived from volcanic lava and ash -Deep fertile loams and clays -Soils of drier parts are highly erodible	1000-2500 though individual peaks rise to>4000m	1000-2000+ (bimodal and varies widely)	Nov - Jan March - June	Feet of Mts. Kilimanjaro & Meru, eastern rift valley extending to L. Eyasi

Zone	Sub-zone	Soils & Topography	Altitude (m.a.s.l.)	Rainfall (mm/annum)	Length of growing season (months)	Representative Areas
The Highlands	6b. Isolated granitic mountains	Ranges from steep sided mountains to extensive highland plateaux. Soils vary according to terrain being deep friable moderately fertile on upper slopes. Shallow stony soils and rock on the steep slopes	1000-2000+	1000-2000+ (bimodal and very reliable)	Oct - Dec March - June	Uluguru mts in Morogoro, the Pare and Usambara ranges, the Tarime highlands
Alluvial Plains	K - Kilombero	-central clay plain -alluvial fans of east and west	N.A.	900-1300 (unimodal, very reliable)	Nov - April	Kilombero district, Morogoro region
	R - Rufiji	-wide delta of mangrove swamps -soils in alluvium, being sandy in the upper stream, and loamy at lower end of flood plain	N.A.	800-1200 (unimodal, often inadequate)	Dec - April	Rufiji, Coast region
	U - Usangu	-seasonally flooded clay in the North -alluvial fans in the South	N.A.	500-800 (Unimodal)	Dec - March	Usangu plains, Mbeya district
	W -Wami	-moderately alkaline black soils in the East. Alluvial fans with well drained loams in the west.	N.A.	600-1800 (unimodal)	Dec - March	Wami in Morogoro rural district

Source: ADIS, 1992

Appendix 4.
Summary of the Farming Systems of Mainland Tanzania

Farming System	Region	District	Main Features	Intensity of Land Use and Environmental Impact	Production Limitations
1. Coffee - Banana/Horticulture The system is based on intercropped coffee and banana on permanent holdings as dominant activities, with some other subsistence crops: maize, beans, potatoes, yams, etc. in separate plots. Two cropping seasons per year are possible. A few head of dairy cattle are commonly kept and stall fed. Fruits and vegetables are also inter-planted. Tea is grown by smallholder farmers and on plantations in the highlands	Arusha, Tanga, Kagera, Mbeya, Kilimanjaro, Ruvuma	Arumeru Lushoto Bukoba, Ngara, Karagwe, Muleba Rungwe, Ileje Moshi, Rombo, Hai, Mwanga Mbinga	Relatively small area of land is suitable for crop production in relation to population. Modern crop technology, Poor soils support pastoral (Arumeru) and other food crop activities. Population density critical in some areas. Complementarity between crops and livestock	Highly intensive farming particularly in Kilimanjaro. Shade trees inter-planted minimize soil degradation especially in Kilimanjaro. Use of mulch and compost manure builds up organic matter and soil erosion control is possible. Soil degradation occurs where conservation measures are not adopted e.g. Usambara mts.	Pests and diseases: -coffee berry, banana weevil, nematodes and sigatoka Scarcity of suitable crop land High production costs for coffee due to need for pesticides and fertilizers
2. Maize/Legume This type of farming is mainly located in the more resource favored areas and is based on pure stands of maize, grown extensively by small holders, with medium technology. As the preferred staple it is also grown in less favored areas, despite the risk of uncertain production. Other food crops (cassava, beans, groundnut some cash crops (coffee, tobacco, pyrethrum) are grown in separate plots.	Arusha, Kagera, Kigoma Mbeya, Rukwa Ruvuma Iringa Shinyanga Tanga, Tabora Morogoro	Hanang, Kiteto, Mbulu, Babati Biharamulo Kibondo,Kasulu Mbeya, Mbozi Sumbawanga, Mpanda, Nkasi Songea Iringa, Njombe, Mufindi, Makete, Ludewa Kahama Korogwe, Handeni Tabora, Urambo Kilosa, Ulanga	Both climate and soils are favorable for maize production, Hanang is also a main wheat growing area. In the past preferential allocation of inputs encouraged surplus production while other remote areas were not favored with market and services.	Deforestation is encouraged due to shifting cultivation. Relative land abundance permits extensive farming to be practices in most maize areas. Short fallow periods are used but do not build up fertility effectively and periods appear to be shortening	Poor marketing infrastructure in remoter areas, factor and product marketing, inefficiencies, resource poor households, lack of or inadequate mechanization

Farming System	Region	District	Main Features	Intensity of Land Use and Environmental Impact	Production Limitations
3. Pastoralist a) Pastoralist Semi nomadic and sedentary cattle raising in the arid and semi-arid zones. Arable cropping limited. Grains obtained from sales of milk or ghee.	Arusha Mara Singida	Monduli, Ngorongoro Serengeti Iramba	Animals keep moving in search of water and fodder. Crop production insufficient to meet the needs of the population, due to unfavorable climate and game reserve restrictions. Fodder basis is open bush, unattended pastures and fallow	Overgrazing may destroy the natural vegetation. Bush fires reduce fodder reserves and may impoverish plant growth and soil conditions.	Water is the main limiting factor for both crops and livestock. Pastures are of poor quality, with a short growing season due to low off-take for cattle.
b). Agro-pastoralist Mixed. Crops are especially sorghum and millets	Dodoma Singida Mbeya Tabora	Kondoa, Dodoma, Mpwapwa Singida, Manyoni Chunya Igunga	Shifting cultivation is largely practiced. Oxen use for cultivation is widespread. Harvest residue, fallow grazing and natural grazing provide fodder.	Slash and burn agriculture destroys environment. Carrying capacity of land is limited and competition for farming and grazing is intense causing soil erosion.	Tsetse fly and ticks infestation limits expansion of livestock. Fodder cropping is non-existent. Calf - mortality rate is very high due to poor veterinary facilities.
4. Livestock, Sorghum, and Millet Livestock production is complementary to crop production. Food crops include sorghum and millets. Cotton is the major cash crop in this system, sometimes competing with upland rice.	Shinyanga Mwanza Tabora	Maswa, Bariadi, Shinyanga, Meatu Kwimba, Geita, Magu Nzega	Uncertain/low rainfall & low tech. levels restrict crop production. Animals depend on grazing land. Pop. density is relatively low. Ridges are used for cash and food crops. Oxen use is widespread.	Continuous risk of overgrazing leading to soil erosion. Ridging helps both soil and water conservation. Use of manure helps to maintain soil nutrient levels.	Uncertain rainfall limits the crop response to inputs in absence of irrigation. Cotton pests and diseases are serious in the zone. Livestock kept for social reasons.

Farming System	Region	District	Main Features	Intensity of Land Use and Environmental Impact	Production Limitations
5. Paddy, Rice, Sugar cane Paddy production is the dominant activity often combined with sugar-cane. Traditional, lowland rice is grown by smallholders while irrigated paddy is mainly large scale, and mechanized.	Morogoro Mbeya Coast	Kilombero Kyela, Usangu plains Rufiji	Rainfall and basic resources are suited to paddy production. Paddy culture has been favored by relatively high prices. Smallholder technology is generally low	Absence of control over water flows in the plains may create health hazards	In lowland areas lack of capital is a limiting factor. Poor farming technology - lack of improved seed, manual cultivation, low inputs, limit production. Salinity may restrict water/land use in plains.
6. Cassava, cashew, coconut Cassava is a draught tolerant crop grown in districts where the soils are less suited to maize. It is grown for consumption and sale. Other food crops are secondary and grown in separate plots. Cashew and coconut are the dominant cash crops and are usually inter-cropped with cassava. Livestock is limited to small numbers of poultry and goats. In lake shore and coastal areas, fish is the main source of protein.	Tanga Coast Lindi Mtwara Ruvuma Mwanza Mara Kigoma	Tanga, Muheza, Pangani Bagamoyo, Mafia Kibaha, Kisarawe, Kilwa, Lindi, Liwale, Nachingwea Masasi, Mtwara, Newala Tunduru Sengerema, Mwanza, Ukerewe Mara, Musoma, Tarime Kigoma	Poor resource base is the main reason for the limited productive performance. Surpluses are generated seasonally in favored areas mainly by maize. Low technology. Extension and support services poor in most areas.	In the absence of alternative production systems fertility is likely to decline because the system consists of perennial or biannual crops which remain on same plots over a long period without additional nutrients.	Cassava pests - mealy bug and mites are a problem. Cassava mosaic virus is a major disease. Low prices and led to dramatic decline of cashew. Sulfur dusting technology is now available but high labor requirement limits rehabilitation. Poor infrastructure limits supply of inputs & marketing of cash crops.

Source: ADIS, 1992